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OPHTHALMIC SURGERY

A MANUAL OF

OPHTHALMIC SURGERY

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WITH ILLUSTRATIONS

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THE present little work is in no way intended to supplant larger works on Ophthalmic Surgery. It is intended only as an introduction to the study, and to supply the student and general surgeon with a short and concise account of the various diseases of, and operations on, the eye, and with just as much information on the subject as every practitioner should possess, although he does not intend to practise ophthalmic surgery as a speciality.

7, DEVONSHIRE STREET, PORTLAND PLACE, W.:
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CONTENTS.

CHAPTER I.

DISEASES OF THE EYELIDS AND LACHRYMAL DUCTS.

PAGE

Tinea Tarsi—Cysts—Hordeolum—Epiphora—Mucocele—Dacryo-cystitis—Lachrymal Fistula—Trichiasis—Entropium—Ectropium 1

CHAPTER II.

OPHTHALMIA AND DISEASES OF THE CONJUNCTIVA.

Simple Ophthalmia — Acute, Subacute, and Chronic—Catarrhal Ophthalmia—Chemosis—Purulent Ophthalmia—Granular Ophthalmia—Phlyctenules—Phlyctenular Ophthalmia—Episcleritis—Pterygium—Pinguecula . . . 10

CHAPTER III.

DISEASES OF THE CORNEA.

Arcus senilis—Corneitis—Interstitial Corneitis—Ulcers—Serpiginous Ulcer—Opacities—Fistula—Staphyloma—Ablation of the anterior part of the Eyeball—Removal of the Eyeball—Xerophthalmia—Hydrophthalmia . . 26

CHAPTER IV.

LENSES AND THE OPHTHALMOSCOPE.

PAGE

Kinds of Lenses: spherical and cylindrical + and – —Principal Focus—Conjugate Foci—Means of calculating Foci—The Ophthalmoscope—Method of using it—Real and virtual Images 38

CHAPTER V.

REFRACTION.

Ametropia and Emmetropia—Accommodation—Presbyopia—Acuteness of Vision—Hypermetropia—Myopia—Muscæ . 47

CHAPTER VI.

REFRACTION—(*continued*).

Astigmatism—Stenopaic Slit—Javal Optometer—Determination of Refraction with the Ophthalmoscope—Difference of Refraction in the two Eyes—Mixed Astigmatism—Irregular Astigmatism—Conical Cornea 62

CHAPTER VII.

GLASSES.

Testing the Refractive Power of Glasses—Focal Length of Glasses—Trial Glasses—Spectacles—Protective Spectacles—Correcting Spectacles—Periscopic and Pantascopic Spectacles—The Adjustment of Spectacle Lenses—Decentralised Glasses 76

CHAPTER VIII.

AFFECTIONS OF THE MUSCLES OF THE EYE.

PAGE

Strabismus—Division of the Rectus Tendon—Diplopia—Insufficiency of the Internal Recti—Nystagmus 83

CHAPTER IX.

AFFECTIONS OF THE IRIS, CILIARY REGION, CHOROID AND VITREOUS.

Paralysis of the Iris and Ciliary Muscles—Spasm—Tension of the Eyeball—Iritis—Iridectomy—Serous Iritis—Irido-Choroiditis—Cyclitis—Sympathetic Ophthalmia—Panophthalmitis 95

CHAPTER X.

CATARACT.

Cataract—Operations for Cataract—Aphakia 111

CHAPTER XI.

AFFECTIONS OF THE RETINA AND OPTIC NERVE.

The Ophthalmoscopic Appearance of the Healthy Retina—The Field of Vision—Scotomata—Phosphenes—Hyperæmia of the Retina—Serous Retinitis—Neuro-Retinitis—Retinitis Syphilitica—Idiopathic Retinitis—Choked Disc—Hæmorrhage into the Retina—White Atrophy—Detachment of the Retina—Retinitis Pigmentosa 127

CHAPTER XII.

GLAUCOMA.

PAGE

Definition—Varieties of Glaucoma—Premonitory Glaucoma—Confirmed Glaucoma—Glaucoma Simplex: Treatment—Acute Inflammatory Glaucoma—Treatment—Chronic Inflammatory Glaucoma—The Glaucomatous Cup—Secondary Glaucoma—Iridectomy in Glaucoma—Treatment of Premonitory Glaucoma 145

CHAPTER XIII.

INJURIES, TUMOURS, AND MALFORMATIONS.

Abrasions and Cuts of the Cornea and Ciliary Region—Foreign Bodies—The Effects of Blows—Effusion of Blood—Rupture of the Sclerotic—Dislocation of the Lens—Malignant Tumours—Glioma—Osseous Tumours—Exophthalmos—Cysticerci—Colour Blindness—Coloboma of Iris and Choroid—Persistent Pupillary Membrane 159

APPENDIX: Formulæ 169

TEST TYPE 180

PLATES 182

INDEX 189

Errata.

Pages 62 and 64, *for* Jarval *read* Javal.
Page 93, *for* Liobrich *read* Liebreich.
Pages 137 and 139, *for* Heurteloupe *read* Heurteloup.

OPHTHALMIC SURGERY.

CHAPTER I.

DISEASES OF THE EYELIDS AND LACHRYMAL DUCTS.

Tinea Tarsi—Cysts—Hordeolum—Epiphora—Mucocele—Dacryocystitis—Lachrymal Fistula—Trichiasis—Entropium—Ectropium.

Tinea Tarsi.—An inflammation of the edge of the eyelids leading to the formation of small pustules and superficial ulcers or excoriations. The edge of the eyelids looks red and raw. There are usually crusts hanging about the roots of the lashes, gluing them together. Sometimes the lashes have small collections of pus around them. In bad cases the edges of the lids are much thickened, the conjunctival lining of the lids is usually very red. Tinea is often exceedingly obstinate, and will last for years if neglected. It usually occurs in delicate children.

Treatment.—All the crusts must be removed:

the surgeon may do this himself with the ciliary forceps. This process is much facilitated by cutting the lashes close: but any lashes surrounded by pus should be removed first, one by one. The margin of the lid should then be painted with a solution of nitrate of silver (1),[1] carefully avoiding the conjunctiva: this had better be done three or four times a week by the surgeon. The most scrupulous cleanliness must be enjoined; and all crusts prevented from collecting by frequent bathing with warm water. Ung. hyd. nit. mit. (17) is to be applied to the edges of the lids every night. If the conjunctiva of the lids is red, two or three drops of Lotio aluminis (11 or 12) should be dropped into the eye three or four times a day. In bad cases if the tears run over the cheeks, which frequently happens, the canaliculus should be slit up, otherwise the treatment will be unsuccessful. The general health of the patient is to be attended to. Tinea may be cured in a week or two by these means, except when the lids are thickened.

Cysts containing sebaceous material are exceedingly common in the lids. They appear as swellings externally, and vary in size from a milletseed to a bean. When the lid is everted the conjunctiva over the cyst is seen to be congested. Such cysts often suppurate: they give rise to considerable irritation, giving the patient a sensation as if some grit were in the eye.

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[1] The numbers in the brackets refer to the formulæ at the end of the volume.

Treatment.—Evert the lid; make a crucial incision through the conjunctiva into the cyst, and clear out its contents with a small scoop. Fotus papaveris, or warm fomentations, may be applied afterwards.

Hordeolum, or **Stye.**—A small indolent abscess or boil in the margin of the eyelid.

Treatment.—Warm fomentations are most comforting. As soon as pus is formed it should be let out. Fotus papaveris is the best application when there is much swelling and irritation. The general health must be improved, and an application of sol. argent. nit. (2) after the stye has healed is said to prevent recurrence.

Epiphora.—A flow of tears over the cheek from obstruction of the lachrymal canaliculus; alteration of the position of the punctum lachrymale by swelling of the edges of the lid; or from inflammation of the lachrymal sac or duct, or its results.

Treatment.—If recent, astringent applications are usually sufficient. Guttæ zinc. chlor. gr. ss. vel gr. j ad ℥j (4 or 5) dropped into the eye three or four times a day, after squeezing out the contents of the lachrymal sac by gentle pressure with the finger below the tendo oculi: this is best done by the patient after a little instruction. If chronic, the upper or lower canaliculus should be slit up. A canaliculus knife is to be passed through the punctum and carried into the lachrymal sac, and the canaliculus slit up by cutting upwards if the lower one, and downwards if the upper one, is operated upon. Avoid wounding the semilunar fold and caruncle—an accident which, however, can hardly happen, as the incision should be strictly confined to the margin of the lid.

The edges of the incision should be separated daily for two or three days with a blunt probe to prevent adhesion. If the epiphora continue, a lachrymal probe must then be passed. To do this, the eyelid is to be drawn gently outward to render its inner portion tense. The probe is then to be passed inwards until it reaches the lachrymal bone. This is easily done if the canaliculus has been properly slit up and the direction of its canal is borne in mind. The neck of the sac is often very narrow, and may offer resistance to the passage of the probe unless it has been divided freely in slitting up the canaliculus. The upper end of the probe must then be turned gently over the forehead so that it takes the direction of the duct. It will pass through the duct into the inferior meatus of the nose without any considerable force if a moderate-sized probe is selected. The direction of the duct is downwards, and, usually slightly backwards and outwards. Its precise direction, however, varies very much; and, if the eyes are widely separated and the nares are narrow, it may be directed slightly inwards instead of outwards. If there is a stricture in the duct the lachrymal probe may have to be passed frequently at intervals of a few days. A silver probe with a bulbous end is to be preferred.

Mucocele.—Chronic or subacute inflammation of the lachrymal sac, giving rise to an accumulation of viscid mucus in its interior. It is generally, perhaps always, due to extension of inflammation either from the conjunctiva or Schneiderian membrane.

Treatment.—One or both canaliculi should be slit up, and the sac must be frequently emptied by digital pressure; immediately afterwards two drops of Guttæ zinci chloridi (4 or 5) should be dropped into the eye. If this treatment does not succeed, passing the lachrymal probe to enlarge the constricted duct will be the proper treatment. The general health of the patient needs attention.

Dacryo-cystitis.—Acute inflammation, with suppuration of the lachrymal sac. It is usually accompanied by very severe pains and tenderness, together with diffuse cellulitis caused by the escape of matter through pin-hole apertures in the sac into the surrounding cellular tissue.

Treatment.—If there is cellulitis a deep incision must be made over the sac and quite down into it. The canaliculus must then be slit up, and the knife carried into the sac, the neck of which is to be divided by a subcutaneous incision, made outwards and forwards. A large probe can then be passed into the inferior meatus. A small piece of lint should be kept in the external wound for a day or two, to allow the free escape of pus. Warm poultices and fotus papaveris should be applied during the cellulitis. The external opening usually heals speedily as soon as the natural duct is restored. If the sac has not opened into the subcutaneous tissue, this will be prevented by at once opening the canaliculi and dividing the neck of the sac; in this case the external incision should be dispensed with. After the severe inflammation ceases, the sac must be washed out with a proper syringe; first with lukewarm water, and afterwards with Guttæ zinci chloridi.

Lachrymal Fistula.—The result of dacryocystitis. Sometimes the margins undergo chronic thickening almost of a cheloid nature, this is the result of long-neglected suppuration.

Treatment.—The first essential is to get a clear passage through the natural duct by the means already indicated. The fistula then usually heals rapidly. If the edges are unhealthy they should be pared away.

Trichiasis. — Growing in of the eyelashes either from slight entropion, or from an irregular disposition of the follicles. The continual irritation owing to the lashes brushing over the cornea is liable to produce corneitis.

Treatment.—The offending lashes may be removed with the ciliary forceps, but will grow again. The only radical cure is to cure the entropium, or to cut the follicles of the lashes out of the ciliary border of the eyelid, a proceeding which gives rise to very little deformity. It is effected in the following manner. A horn spatula made for the purpose is passed under the lid to render it tense and to protect the eyeball. An incision is now made about a quarter of an inch deep along the edge of the lid parallel to and within the roots of the cilia. A second incision is next made through the skin in a plane at right angles to the former along the whole length of the lid meeting the first incision, so that a strip of skin is removed containing the roots of the lashes. A few fine sutures are used to unite the edges of the wound.

Entropium.—Inversion of the eyelid, usually accompanied by spasmodic contraction of the orbicularis and considerable irritation and inflammation of the eye.

Treatment. — The best treatment is a free division of the tarsal cartilage from end to end, and about two lines from its margin. This operation is performed from the conjunctival surface by everting the lid. The knife must be kept vertical to the surface of the cartilage; as, unless care is taken, this will be cut very obliquely, and no good will be done. The operator must avoid wounding the skin. If the opening of the lid is much contracted it should be enlarged by slitting up the outer canthus.

Ectropium.—Eversion of the eyelid, so that the eye cannot be closed, and hence loses its normal protection. The cornea is liable under these circumstances to undergo ulceration; and, unless an operation is performed, the whole eye may become inflamed, or at least useful vision will be lost.

The method of treatment adopted by Mr. Bowman is to pare the edges of the lids from about a line from the outer canthus to midway between it and the inner canthus, and then to divide the skin and orbicularis freely around the lids so that no tension remains; and to unite the edges of the lids by two sutures. The outer wound, which gapes considerably, is allowed to heal by granulation; after some weeks the lids may be again separated. The cornea usually soon recovers its brightness when it gets its normal protection, and the ectropium is generally removed by the relaxation produced in the parts. Skin grafts may be advantageously planted in the outer wound; or a plastic operation may be performed at a later date.

CHAPTER II.

OPHTHALMIA AND DISEASES OF THE CONJUNCTIVA—OPHTHALMIA.

Simple Ophthalmia — Acute, Subacute, and Chronic—Catarrhal Ophthalmia — Chemosis — Purulent Ophthalmia — Granular Ophthalmia—Phlyctenules—Phlyctenular Ophthalmia—Episcleritis—Pterygium—Pinguecula.

Ophthalmia signifies inflammation of the conjunctiva, and not of the eye as its derivation would indicate.

It is of the utmost importance to learn to distinguish the various forms of ophthalmia, both from each other and from deeper affections of the eyeball. Inflammation and ulcers of the cornea may accompany ophthalmia; these are then usually the graver affections, and should at least always receive attention. When the cornea is not implicated, vision is not impaired in ophthalmia, except by the accumulation of a film of tears, or mucus upon the cornea, and the iris is perfectly active under the stimulus of light.

One of the most important distinctions between the various forms of ophthalmia, in a practical point of view at least, was pointed out by Mr. Critchett as early as 1854,[1] although it has hardly received the attention it deserves. Some forms are characterised by an increased watery secretion—excess of tears. Such are simple pustular and strumous ophthalmia: these rarely bear astringent lotions. Other forms, catarrhal and purulent ophthalmia, are characterised by a mucous, muco-purulent, or purulent discharge; and these demand astringent applications.

These two types of inflammation differ no less in their sequelæ than in their indications for treatment and the character of the secretion. In the one group characterised by aqueous secretion the tendency is to ulcers of the cornea; in the other to the formation of granular lids and pannus of the cornea. This latter group is distinctly contagious and endemic in its character.

Simple Ophthalmia is characterised by the entire absence of all increased mucous or muco-purulent secretion from the surface of the conjunctiva, but large quantities of more or less acrid tears take its place. The congested vessels form a distinct network on the surface of the conjunctiva; and these can be moved upon the globe by placing a finger on one of the lids and sliding it over the eyeball, thus showing their superficial nature. The patient complains of smarting pain in the eye, or of a feeling of heat.

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[1] 'Lancet,' 1854. 'A Course of Lectures on Diseases of the Eye,' by G. Critchett, Esq., F.R.C.S.

Acute Simple Ophthalmia is either due to the presence of a foreign body under the eyelid or on the cornea, or it may result from an abrasion of the cornea; the application of some acrid or irritating substance to the conjunctiva; or from constitutional disturbance, such as exposure to cold, more especially when the digestive functions are impaired.

Treatment.—Our attention must first be directed to removing the cause, whether local or general. Foreign bodies should always be looked for by inspecting the cornea and everting the upper lid; as the patient is frequently unaware of the presence of a foreign body, although one may have found admission into the eye. Astringent lotions always do harm in these cases. Warm poppy-head fomentations are very good when the attack is severe, or a cool evaporating lotion may be applied. As in other forms of local inflammation the question whether an application shall be warm or cold must be determined by the feelings of the patient. Mr. Critchett's Lotio ammon. acetatis is a grateful application (14). In cases of constitutional origin a purgative is often the best remedy. In the more severe cases due to injury of the cornea the treatment must be directed against corneitis (see Chapter XI.).

Subacute Simple Ophthalmia.—The eye is more irritable and more highly injected. The injection is of a darker colour: this condition is frequently complicated by ulcer of the cornea. The eyelashes are often glued together in bundles by the abundant vitiated frothy tears. Subacute ophthalmia is almost always a constitutional affection, and is usually due to some continuous drain upon the system, such as protracted lactation, excessive menorrhagia, or it may result from bad food, &c.

Treatment.—Removal of the cause and generous diet are the main indications for treatment. Locally astringents are harmful, often producing corneal mischief where none existed previously. Fotus papaveris is perhaps the best local application, but cooling lotions (14 to 16) may sometimes be substituted with advantage. Flying blisters are often useful in obstinate cases.

Unless the cornea becomes implicated, the only permanent structural change which results from simple ophthalmia seems to be the formation of little chalky nodules, which give a grating sensation when touched with the point of a needle, beneath the conjunctiva of the lid. They only occur in protracted cases, but are common in the chronic form.

Chronic Ophthalmia may be a sequel of the subacute form: it usually occurs in old and feeble persons. There is commonly no marked injection of the conjunctiva; but the patient complains of smarting, with excessive secretion of tears, which gives the eyes a weak and watery appearance. The conjunctiva of the eyelids in this affection is always more or less congested, and minute gritty deposits occur on its surface, giving rise to considerable irritation.

Treatment.—This condition may be alleviated by good diet. Stimulants and astringents are indicated locally. Gtt. zinc. chlor., Lotio aluminis and Lotio zinci (10 or 11) may be prescribed. Ung.

flavum (19) or a solution of sulphate of copper (9) applied with a camel's hair brush often does good. It is apparently most important to change the stimulant when it no longer acts beneficially.

Catarrhal Ophthalmia usually occurs simultaneously amongst a number of members of a family or community; it is a sporadic and undoubtedly contagious affection. The conjunctiva becomes suddenly injected, and soon assumes a uniform velvety deep red appearance, a large quantity of mucus or muco-purulent secretion forms upon its surface, and in severe cases the conjunctiva is raised in folds round the cornea—chemosis—by the infiltration of the sub-conjunctival tissue with serum. The patient complains that the eye smarts or throbs. The lids are usually closed, and in severe attacks are red and swollen, with more or less mucous or muco-purulent secretion accumulated within their margins.

Treatment.—As has been already stated, as a rule, astringent lotions are indicated in all those forms of ophthalmia in which there is increased mucous or muco-purulent secretion, just as they are contra-indicated in those forms in which the secretion consists entirely of an increased, although vitiated, flow of tears. A few drops of Lot. aluminis (11 or 12) should be introduced into the eye every hour or two; and, in cases in which the discharge is at all copious, the lotion should be used freely with a small glass syringe after having washed away the muco-purulent secretion by the same means with a little lukewarm water.

Poultices should never be applied for conjunctival inflammation of any kind. The general treatment is that of ordinary catarrh, which often accompanies the ophthalmia. There is no need or use in scarifying the chemoses, as was formerly recommended. It is rare, in this country at least, for an eye to be lost from catarrhal inflammation, however severe. Cases in which the eye is lost can generally be traced to inoculation with pus.

Purulent Ophthalmia.—Severe and often destructive inflammation of the conjunctiva, characterised by the formation of thick yellow pus on its surface.

No sharp line can be drawn between purulent and severe catarrhal ophthalmia by the mere appearance of the eye; but the most disastrous cases, in this country at least, are the result of inoculation of the eye with pus. In crowded workhouses and barracks it sometimes assumes an endemic form. The ophthalmia of new-born children and gonorrhœal ophthalmia are forms of this disease. If neglected it almost inevitably leads to destruction of the eye, especially when due to gonorrhœal pus; ulceration and perforation of the cornea, leading to staphyloma and panophthalmitis are too frequently its results. In children prompt treatment at an early stage usually saves the eye.

Treatment.—The eye should be washed out every hour, or even oftener, with a syringe, first with lukewarm water and then with Lotio aluminis (12). Great caution is necessary to prevent the pus from finding admission into the other eye of the patient if only one is affected, or into those of the surgeon or nurse. In adults leeches should be applied to the temple. When only one eye is affected, the safety of the other must not be left to chance, but it should be covered with some charpie,[1] strapping, and a thick layer of collodion over all. This protective strapping must be removed and renewed twice a day, and the eye examined on each occasion to see that it is not affected.

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[1] Fibres pulled out from old linen.

Diptheritic Ophthalmia is even more destructive in its results than purulent ophthalmia. Fortunately it does not occur in this country, or occurs very rarely indeed if at all. It is characterised by the infiltration of the conjunctiva with diphtheritic exudation, giving rise to a complete arrest of circulation. It is best treated, perhaps, by getting the patient under the influence of mercury as quickly as possible.

Granular Ophthalmia.—This is one of the most distressing and obstinate affections seen by the ophthalmic surgeon. It is endemic in crowded and badly nourished communities, especially in reformatory and workhouse schools, and is characterised by the occurrence of minute vesicular-looking bodies, almost like an herpetic eruption, but really solid, on the conjunctiva of the lids. This affection may arise from neglected catarrhal or purulent ophthalmia, or more probably from a distinct but kindred form of disease. The conjunctiva is more or less acutely inflamed, especially on the lids, and its surface becomes velvety, like the surface of a granulating ulcer; as this condition progresses it extends to the ocular conjunctiva, the vessels of which gradually spread to the cornea, generally first invading its upper border. The cornea then becomes covered by a thin opaque vascular layer which is quite superficial (pannus); this ultimately becomes so opaque that all vision is lost. In granular ophthalmia the vesicular granulations are sometimes absent even from the first; in old cases the mucous surface is entirely destroyed in patches, and its place is occupied by dense white cicatricial tissue.

Treatment.—Gtt. atropiæ should be used in the more acute form; the lids should be everted and painted over with a solution of nitrate of silver (2), which should be immediately washed off with a saline solution (3); other forms of caustic application are necessary when the nitrate of silver has been long used, as, a solution of sulphate of copper, and mitigated crayons of nitrate of silver and sulphate of copper.

In the chronic form, when the orbicularis is tense, the longitudinal division of the tarsal cartilage of the upper lid parallel to its margin often does much good by relieving the pressure it exerts on the eye. This is to be done from the conjunctival surface, by everting the lid. The whole thickness of the cartilage must be cut through, but care must be taken not to wound the skin.

In cases of complete pannus of the cornea, inoculation of the eye with pus from a case of mild infantile purulent ophthalmia is recommended and sometimes does good. The operation is most serious; for the arguments for and against this proceeding the reader is referred to larger works on ophthalmic surgery. (Consult J. Soelberg Wells, 'Treatise on Diseases of the Eye.')

Peritomy, or the removal of a circular strip of conjunctiva about a fourth of an inch wide from the margin of the cornea, either from the whole or a part of its circumference, is said to have a most beneficial effect upon vascular conditions of the cornea, especially when the changes are superficial, as in pannus. The operation is performed by seizing the conjunctiva with a pair of forceps at rather more than a quarter of an inch from the margin of the cornea, and cutting through its whole thickness, and then carrying the scissors, which should be curved and blunt pointed, round the cornea, as in the operation for removing the eyeball, keeping a fourth of an inch from its margin or rather more, and then dissecting the strip of conjunctiva off the eyeball and removing it with the scissors close to the margin of the cornea; the excessive blood-supply is thus in part at least effectively cut off, in a few days the wound heals, and the transparency of the cornea is often ultimately restored as the cicatrix contracts. Partial peritomy is useful in vascular ulcers of the cornea, by effectually dividing the offending vessels.

Phlyctenules of the Conjunctiva.—Small vesicles due to exudation immediately beneath the epithelium, the size of a pin's head or larger, which occur in delicate subjects, especially in children, usually near the margin of the cornea. They are surrounded by a halo of congested vessels, ultimately become pustular, and break. They last a week or ten days on an average.

Treatment.—When not accompanied by ophthalmia or photophobia they may be treated by dusting a little calomel into the eye every two or three days. The general health of the patient needs attention, as they are very liable to recur.

Phlyctenular Ophthalmia. (*Strumous Ophthalmia.*)

Inflammation of the conjunctiva with more or less numerous phlyctenules, often upon the cornea as well as the conjunctiva. There is great intolerance of light, and often much pain and extreme photophobia. The conjunctiva is exceedingly vascular, and there is excessive secretion of acrid tears, which often excoriate the lids and face, and even produce eczema of the cheek. It occurs chiefly in strumous children and young girls, especially after measles. It is very liable to recur and to be complicated with ulcers of the cornea.

Treatment.—In severe cases with much photophobia, the eye may be covered with a compress of charpie, which should be frequently changed and kept wet with fotus belladonnæ (22). In less severe cases gtt. atropiæ or fotus belladonnæ should be used, and the eyes carefully protected from strong lights. Sometimes belladonna and atropine set up great irritation, causing the lids to inflame and producing much lachrymation and redness of the conjunctiva. When they cannot be applied in this form, the extract may be applied to the brow, or the tincture administered internally, simple cerate is often useful to keep the lids from sticking together, especially at night. When the irritation and photophobia subside, Lot. aluminis c. atropiâ (13), should be used frequently; a small piece of Ung. flavum (19) may be advantageously introduced into the eye once or twice a day, or the phlyctenules treated by calomel dusted into the eye. Great regard must be paid to the general health. The extremities of children suffering from this disease are often very cold; keeping these warm and well-clothed has a most beneficial influence on the ophthalmia. The appetite is usually perverted and uncertain; parents should be enjoined to enforce a healthy diet at regular intervals only. Cod liver oil, vinum ferri, and pulvis ferri carbonas cum saccharo are useful adjuvants.

Episcleritis.—A dusky crescent of congested vessels appear usually on the outer side of the cornea; there is swelling in this region with dull pain and tenderness, lacrymation and fatigue, whilst the edges of the cornea gradually become irregularly invaded by new tissue resembling the sclerotic in appearance, so that its margin is no longer circular. The inflammation is of a low kind, and appears confined to the subconjunctival tissue at first, gradually extending to the ciliary region and cornea. It is commonly seen in women, and appears to be connected with uterine irritation, suppressed menstruation, and the cessation of the uterine functions. It is very tedious and liable to recur, and is quite unaffected by any local treatment.

Treatment.—Chalybeates, attention to uterine symptoms, and a generous diet are indicated, and if the inflammation extends to the ciliary region belladonna or atropine must be used. The pain should be combated by the judicious administration of opium.

Pterygium.—A fleshy growth on the conjunctiva, usually extending from the inner canthus to the edge of the cornea.

Treatment.—The growth should be dissected out, except at its inner angle, and transplanted beneath the lower lid. The conjunctiva is to be divided by a horizontal incision about a line below the level of the lower edge of the cornea to a sufficient extent to contain the pterygium, which is to be held in its new position with sutures, the conjunctiva between the two incisions being shifted upwards into the position originally occupied by the pterygium. Or the pterygium may be simply tied by passing a ligature under its outer and inner extremities.

Pinguecula.—Two or three small lobules of fat, sometimes form between the cornea and the inner canthus. It is best not to touch them, as they are not inconvenient and do not increase. If the patient insists, they may be removed with a snip of the scissors.

CHAPTER III.

DISEASES OF THE CORNEA.

Arcus senilis—Corneitis—Interstitial Corneitis—Ulcers—Serpiginous Ulcer — Opacities — Fistula — Staphyloma —Ablation of the anterior part of the Eyeball—Removal of the Eyeball—Xerophthalmia—Hydrophthalmia.

Arcus senilis.—A white ring round the cornea, the result of fatty degeneration of its edge. It comes on at various ages like grey hair; it is undoubtedly a form of senile change, but, like grey hair, it affords no positive indication of declining powers.

Corneitis.—The strumous form of this disease is very common, and usually occurs in conjunction with phlyctenular ophthalmia. The cornea becomes vascular and dim, phlyctenules and ulcers are formed upon its surface. A far more serious form of corneitis, however, is liable to occur in debilitated persons, which leads to suppuration between its laminæ (onyx) especially after operations and injuries, such as blows, impaction of foreign bodies in the cornea, or even from abrasion of its surface. The symptoms of corneitis are dimness, or dimness and vascularity of the cornea, and usually copious lachrymation. The colour of the zone round the cornea is pinker in all forms of corneitis than in ophthalmia, owing to the implication of the vessels of the sclerotic.

Treatment.—In all affections of the cornea, Guttæ atropiæ, Fotus belladonnæ, and careful protection from light are the most important remedies. Phlyctenular corneitis requires the same treatment as phlyctenular ophthalmia. In corneitis from injury or foreign bodies, leeches should be applied to the temple. Any foreign body must be removed. If suppuration occur, a broad needle should be passed through the abscess which should be completely divided by cutting outwards. Sometimes the pus has already made its way into the anterior chamber, and may be seen lying at its lower part (Hypopion). If this has occured, the cornea should be punctured (paracentesis of the anterior chamber) at its inferior margin with a broad needle, the blade being kept parallel to the sclerotic margin during the puncture, and then rotated slightly, to allow the pus to escape. This must also be done to relieve tension of the eyeball if it be excessive, even although the pus has not found its way into the anterior chamber; or the needle used in opening the abscess may be passed through the whole thickness of the cornea, when the escape of the aqueous humour washes out the pus before it. Great care must be taken not to wound the crystalline lens. No caustic or astringent applications are admissible in corneitis. Another most important point to bear in mind is that any fine solid particles suspended in fluid are exceedingly liable to be absorbed by the corneal corpuscles; hence Goulard water (Lotio plumbi) should never be used. The cornea may be rendered permanently opaque in a few hours by its use, even when only the slightest abrasion exists on its surface.

In adults opium is a most useful adjuvant, as it relieves pain, and likewise accelerates recovery.

The great danger of phlyctenular or strumous corneitis is the production of perforating ulcers or of opacities of the cornea from the healing of corneal ulcers. Suppurative corneitis is a far graver malady, as the ciliary region is apt to become implicated, and the eye may easily be lost.

Interstitial Corneitis.—A third and specific form of corneitis in which the cornea appears hazy or milky, with a few vessels ramifying in its substance; sometimes the vessels are numerous, but they do not appear on the surface as in pannus. The opacity may be very great in the centre of the cornea, and of a buff yellow colour. There is often both pain and photophobia. Iritis is liable to accompany the disease. There is in general no tendency to abscess or ulceration. The disease runs a very definite course, and is exceedingly liable to recur. It usually begins with a slight central dulness, which extends outwards and becomes more and more opaque in the centre; sometimes no vessels appear; after some weeks or months the opacity becomes very dense, then reparative processes commence, and it gradually clears away. The disease usually affects both eyes simultaneously, and is undoubtedly very frequently, if not always, due to inherited syphilis. It is frequently accompanied by deafness, the characteristic teeth first described by Mr. Hutchinson, and other evidences of inherited syphilis. The prognosis is almost always favourable.

Treatment. — Iodide of potassium, bichloride and mercury, and iodide of iron, undoubtedly exert a beneficial influence on this disease. Guttæ atropiæ should always be used, especially if there is any pain or evidence of inflammation indicated by a zone of congested vessels around the cornea.

Ulcers of the Cornea.—An ulcer on the cornea may apppear as if a piece of the cornea had been chipped out; such ulcers often become vascular by the formation of a fasciculus of vessels running from the edge of the cornea. A vascular ulcer of this kind is often very chronic. When ulcers of the cornea heal, they usually produce opaque white scars (leucomata). Sloughing ulcers appear as white, opaque, irregular, almost woolly-looking spots on the cornea; they often perforate it, protrusion of the iris and staphyloma may occur as the result of such perforations.

Treatment.—The treatment of ulcers of the cornea is the same as that of phlyctenular ophthalmia and corneitis. If, however, they become chronic and vascular, a seton of a single thread put into the temple under the hair, so that the scar is not visible, is far the best treatment; partial peritomy may also be performed in obstinate cases. Unguentum flavum (19) is useful in chronic ulcers; keeping the extremities warm and good diet must be enjoined.

Sometimes partial peritomy, that is the removal of a band of conjunctiva and subconjunctival tissue about two lines broad from the margin of the cornea from which the ulcer receives its vessels, will cause an obstinate corneal ulcer to heal.

Serpiginous or Spreading Ulcer of the Cornea is a most destructive form of disease. It chiefly occurs in broken-down constitutions, especially in women when the uterine functions cease. It is exceedingly liable to lead to iritis and a collection of pus in the anterior chamber (hypopion).

Treatment.—Various remedies have been recommended, but none are entirely satisfactory. Division of the ulcer with a broad needle entering the anterior chamber, repeated daily as long as the ulcer continues to spread, is said to be the best treatment, especially when an hypopion has been formed. Perhaps belladonna and a change of diet and habit have the most beneficial effects;

if hypopion occur, paracentesis of the cornea must be performed.

Opacities of the Cornea.—Slight opacities of the cornea, due to the healing of superficial ulcers, are called nebulæ. When they occur in young children they are very liable to disappear gradually. Their disappearance is accelerated by attention to the general health; dusting calomel into the eye has also apparently a beneficial influence. Dense white opacities (leucomata) occur as the result of deep ulcers; even these in children often become considerably reduced in time. When they persist, if they are central and occur on both eyes, an artificial pupil[1] may be made opposite the most transparent portion of the cornea; when they are marginal they are unsightly. If desired, the appearance may be much improved by tattooing them with Indian ink. This may be conveniently done by puncturing the leucoma with a crowquill steel pen charged with Indian ink, or with a grooved needle. The former instrument appears to be the simplest and most efficacious.

Fistula of the Cornea.—Sometimes a perforating ulcer leaves a small opening in the cornea from which the aqueous continually escapes, so that the iris falls forward, and usually contracts an adhesion with the cornea.

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[1] See Iridectomy.

Treatment.—An iridectomy should be performed opposite the most transparent part of the cornea, not, as is sometimes recommended, close to the fistulous opening. If the wound does not then heal, Mr. Bowman pares the edges of the fistula, and even unites them with a fine suture of silk. This is an operation requiring the greatest skill and most delicate manipulation.

Staphyloma.—A bulging of the ciliary region or cornea. The cicatrix formed by the healing of a large ulcer of the cornea, or of a wound of the sclerotic, is very liable to give under the normal intra-ocular pressure, and to give rise to a very unsightly swelling. The iris is usually involved both in the cicatrix and the swelling. Ciliary staphyloma occurs more rarely as an idiopathic affection.

Treatment.—If vision is not already lost, the best chance of arresting the staphyloma is a large iridectomy, especially when it occurs in the ciliary region. When the eye is already lost for all purposes of vision, and the surgeon has the choice between removing the whole eyeball or its anterior portion only, the latter operation leaves a stump for an artificial eye to rest on, so that it follows the movements of the other eye; if the ciliary region be entirely removed, there appears to be no danger of sympathetic ophthalmia; hence where appearance is important this is clearly the preferable operation.

In ablation of the anterior portion of the eyeball, Mr. Critchett's method of operating is as follows. The patient is put under the influence of chloroform or ether, and the eyelids separated by a stop speculum. Four curved threaded needles are then passed through the eyeball at equal distances from each other, so that they pass into and out of the sclerotic a little behind the line of insertion of the four recti. The eyeball is thus vertically transfixed by all four needles, but these are not drawn through at this stage of the operation. A knife is required to make an opening in the sclerotic just in front of the outermost needle, and a pair of scissors is then used, one of the blades being inserted through the wound; the anterior portion of the eye is removed by cutting round close to but in front of all the needles. The needles are to be drawn through, and the sutures tied so as to bring the edges of the wound into apposition.

If the removal of the entire eyeball is decided upon, it is performed in the following manner.

Removal of the Eyeball.—The patient is placed under chloroform or ether, and the eyelids separated by a stop speculum. A piece of conjunctiva and subconjunctival tissue is to be picked up with a pair of forceps close to the cornea, and divided with a pair of scissors; one blade is then inserted under the conjunctiva and subconjunctival tissues, and these are divided all round, as close to the cornea as possible. The muscles are next picked up one by one with a blunt hook which is passed under them, its point being kept close to the sclerotic, and divided by the scissors. When all the muscles are divided the eye can be made to protrude by making pressure upon the outer portion of the orbit, or rather between it and the eye; a pair of curved scissors are now passed down close to the sclerotic on its inner side, and the optic nerve is divided about two millimeters behind the sclerotic. When the eyeball is removed for malignant tumours, as much of the nerve as possible should be removed.

Some operators bring the edges of the wound in the conjunctiva together with sutures; others do not. This is usually hardly necessary. The bleeding is easily stopped except in cases of malignant disease, by closing the lids and binding a small wet sponge firmly over them. This should be left for twenty-four hours. The eyelids are to be simply covered afterwards by ordinary water-dressing.

An artificial eye may be worn usually about three months after the operation. Sometimes the conjunctiva of the socket becomes inflamed and œdematous even some weeks after the operation. Mild astringent lotions are then indicated, Guttæ zinci chloridi (4), or Lotio aluminis (11). Sometimes a button of granulations forms over the position of the stump of the optic nerve; this should be snipped off with a pair of scissors.

The scissors used in removal of the eyeball are curved and somewhat larger than those used in the operation for squint.

When an artificial eye is worn, it should be changed for a new one at least once a year, as its edges become rough and set up inflammation in the socket unless this is done.

Xerophthalmia.—Fortunately a very rare disease, usually due to the action of escharotics, such as lime, acids, &c. The epithelium of the cornea and conjunctiva becomes dry and horny, like that of the skin. It produces great discomfort and of course blindness.

Treatment.—Closing the eye by paring and uniting the lids is perhaps the best treatment. After some weeks or months the lids may be again separated, but even when the best results have been obtained, the dryness usually soon returns when the eye is again opened. It has been proposed to make a permanent opening in the upper lid in front of the pupil, the lids being kept closed. A successful case is reported by Dr. Buller of Montreal.[1]

Hydrophthalmia.—A rare disease, in which the anterior part of the eyeball becomes very much enlarged. The cornea projects abnormally, and the iris appears as if torn from its attachment. It occurs only in children, and is perhaps always a congenital affection which progresses steadily from birth.

Treatment.—Iridectomy may be tried, but nothing will probably arrest the progressive nature of the disease. The function of the eye is rapidly destroyed, and the question of removal sooner or later presents itself.

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[1] Royal London Ophth. Hosp. Reports, vol. viii. p. 421.

CHAPTER IV.

LENSES AND THE OPHTHALMOSCOPE.

Kinds of Lenses: spherical and cylindrical + and – —Principal Focus—Conjugate Foci—Means of calculating Foci—The Ophthalmoscope—Method of using it—Real and virtual Images.

Lenses, commonly called glasses, are either spherical or cylindrical. A spherical glass has its surface curved in every direction equally, and is therefore a portion of a sphere. A cylindrical glass is curved in one direction, its surface is a portion of a cylinder. Such glasses have their axis of curvature marked: the mark should indicate the axis of the cylinder of which the glass may be considered to be a portion; it is the line of no curvature on the glass. Some glasses have the mark at right angles to the axis.

Both spherical and cylindrical glasses may be either convex, or concave; a convex glass is thicker in the centre than at the edge; it is considered + or positive; a concave glass is hollow towards the centre, and fits upon a sphere or cylinder; it is reckoned as — or negative.

The focus of a positive spherical glass is the distance from it at which a definite picture of distant objects would be made upon a screen (in optical language, the distance behind it at which parallel rays of light falling upon it come to a point or focus). The more powerful, *i.e.*, the more curved a glass, the shorter its focal length; hence if a lens with its focus one inch behind it be considered to have the unit power, a glass with its focus two inches behind it is said to have half, and one with its focus three inches behind it, one-third of the unit power. In ordinary glass lenses with one curved face and one flat face, the distance of the focus is about twice the diameter of the sphere, of which the face forms a part. In glasses with two convex curved surfaces of equal curvature, the focal length and the diameter of the sphere of which either surface is a part are nearly equal. The power of the glass is the reciprocal[1] of the focal length. Convex glasses are spoken of as $+\frac{1}{12}$, $+\frac{1}{24}$, $+\frac{1}{30}$, &c. A convex glass with 12 inches focal length is called $+\frac{1}{12}$; it has $\frac{1}{12}$ the power of a glass of one inch focal length.

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[1] The reciprocal of a number is 1 divided by the number: *i.e.* $\frac{1}{12}$ is the reciprocal of 12.

Concave glasses have no real focus, because the light rays diverge from each other after passing the glass, but a concave glass has an imaginary focus, that is a point in front of it where the rays which have passed through it appear to come from. The power of a concave glass is the opposite of a convex one, and is written $-\frac{1}{12}$, $-\frac{1}{24}$, because it neutralises a convex one of equal curvature.

The power of two glasses is always found by taking the sum or difference of their powers, according as they have the same or opposite signs. For instance, the effect of

$+\frac{1}{12}-\frac{1}{12}=0$, or they neutralise each other.

$+\frac{1}{12}+\frac{1}{12}=\frac{2}{12}=\frac{1}{6}$

$-\frac{1}{12}+\frac{1}{24}=-\frac{2}{24}+\frac{1}{24}=-\frac{1}{24}$ &c.

A cylindrical glass has no proper focus; its use will be considered under Astigmatism.

The focus hitherto considered is called the principal focus, or the focus of parallel rays of light. A spherical convex glass has also what are called conjugate foci, *i.e.* foci on either side of the lens which belong to each other; that is, rays of light coming from any point or object in front of the glass, not nearer to it than its principal focus, come together again in a point behind the glass and form an image. To find the conjugate focus for any point, we have only to subtract the reciprocal of the distance of the point in front counted in inches (or the distance of the object from the glass) from the focal length of the glass, and we find the reciprocal of the distance of the corresponding focus behind the glass (or the position of the image).

For instance: suppose with a glass having a power of $+\frac{1}{12}$ rays come from a very great distance counted in inches, say from 300 inches; we have—

$$+\tfrac{1}{12} - \tfrac{1}{300} = \tfrac{1}{12} \text{ nearly.}$$

In practice it is usual to neglect any fraction smaller than $\frac{1}{240}$. Again, suppose we have an object 12 inches in front of a convex glass of 12 inches focus, we have $+\frac{1}{12}-\frac{1}{12}=0$, that is, no image will be formed. Indeed, the rays will be parallel when they leave the glass. It is usual to write this $\frac{1}{12}-\frac{1}{12}=\frac{1}{0}$, which shows that an image should be formed at an infinite distance. Of course no image can be formed behind the glass if the distance of the object is still further decreased.

Again, suppose the object 24 inches in front of the glass we have—

$$\frac{1}{12} - \frac{1}{24} = \frac{2}{24} - \frac{1}{24} = \frac{1}{24},$$

or the glass will produce an image 24 inches behind it.[1]

The Ophthalmoscope.—Liebrich's ophthalmoscope is the most useful to the beginner. The instrument consists of a perforated mirror with an arrangement for fixing a lens behind the perforation. Unless the observer's eye has an abnormal refractive power, he will probably see best by putting a + $\frac{1}{10}$ lens behind the perforation. This lens can be turned aside at pleasure. There are likewise two large lenses, sometimes called oculars. One of + $\frac{1}{2\frac{1}{2}}$ and one of + $\frac{1}{3}$ (refractive power) or 2·5 or 3 inch foci.

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[1] In Optics the equation used is $\frac{1}{F} - \frac{1}{d} = \frac{1}{f}$, where F = the principal focus, d the distance of the object, and f that of the image. When d is less than F, $\frac{1}{f}$ is counted negative, which shows that the focus is imaginary and on the same side as the object, as in concave lenses.

To use the Ophthalmoscope.—Place the patient in a dark room with a good lamp, level with the eye, just behind the ear and about six inches from the patient's head. It is best not to have too bright a light, as this will cause the patient's pupil to contract too much, unless atropine is used, when it is still necessary not to employ too bright a light, or the patient will soon be fatigued. It is better to practise on a healthy eye, a friend's or fellow-student's, and to avoid fatiguing the observed eye. The right eye of the patient is best observed with the right eye of the surgeon; sitting in front of the patient, he takes the mirror in his right hand between his finger and thumb, and turning the small lens out of the way, tells the patient to look at the tip of his right little finger, which he should hold up level with the opening in the mirror. The mirror should be held close to the eye of the operator, and about fifteen inches from that of the patient. The success of the operator will depend at first very much upon the direction in which the patient looks. The surgeon then reflects the light from the mirror into the patient's eye, endeavouring to make the shadow of the hole in the mirror fall on the patient's pupil. When the patient's eye looks in the right direction, his pupil will dilate and the surgeon will most probably see a white reflection in the pupil. When this has been successfully accomplished, the surgeon takes one of the oculars—the strongest is the most easy to use unless the patient is short-sighted—holding it between the forefinger and thumb of the left hand, and steadying his hand by resting the little and ring fingers on the patient's temple, he holds the ocular about two and a half inches in front of the patient's eye. He should now replace the small lens behind the opening in the mirror, and move his head nearer or further from the patient, until he obtains a perfectly distinct image of the entrance of the optic nerve, or the *optic disc*, and the arteries and veins of the retina entering its central point, and ramifying on its surface.

The image which he now sees, if he has been successful, is a magnified *reversed* and *inverted* image of the retina: it is really formed in the air between him and the ocular. It is called a real image, because the rays of light coming from the retina of the patient really meet and form a picture in the air. A good deal of practice is usually necessary before the observer can be sure of seeing the fundus or back of the eye distinctly.

When the fundus can be distinctly seen, the retina can be explored by causing the patient to look in different directions. This is far more difficult, as the pupil contracts owing to the rest of the retina being sensitive to light. In exploring the sensitive portions of the retina, as a rule, the lens and mirror must retain their original positions. The periphery of the retina may also be explored by making the patient fix his eye, whilst the operator moves the ophthalmoscope. The chief difficulty with the beginner is, perhaps, that he arranges the glasses so that he sees the iris and not the retina. He must learn to disregard the image of the iris.

There is another method of using the ophthalmoscope without the ocular, and by this the observer sees a highly magnified erect image, which is not reversed. This image is called a virtual image, because the rays of light do not meet where the image is seen; it appears further from the observer than the patient's retina. To see the erect image, the eye of the operator must be so placed, that rays of light coming from the retina of the patient fall in a focus on the retina of the observer. This method of observation will be described under the article on the ophthalmic determination of the refractive condition of the patient's eye.

CHAPTER V.

REFRACTION.

Ametropia and Emmetropia—Accommodation—Presbyopia—Acuteness of Vision—Hypermetropia—Myopia—Muscæ.

Refraction.—As is well known, a picture of external objects is formed upon the retina by the lens system of the eye, just as one is formed on the sensitive plate of the photographer's camera. When the retina is healthy, and the transparency of the refractive media of the eye unimpaired, the accuracy and acuteness of vision depend, so far as the eye is concerned, on the accuracy of the image produced on the surface of the rod and cone layer of the retina.

Emmetropia and Ametropia.—Emmetropia is the condition in which a perfect picture of distant objects is formed on the retina when the eye is at rest. Ametropia is the general term used to express any deviation from the condition. It includes *Myopia*, or short sight, *Hypermetropia*, sometimes called long sight, and *Astigmatism*.

Accommodation is the power we possess of focusing the eye for near objects. As has been already stated, the conjugate focus of any point near a lens is further from the lens than its principal focus. Hence suppose an eye in which the principal focus, that for parallel rays or distant objects, falls on the retina, that for a near object falls behind it. Increase in the convexity of a lens shortens its focus; the focus of the eye is shortened by increasing the convexity of the crystalline lens. This is done by contraction of the ciliary muscle, a non-striated muscle which surrounds the lens. The increased convexity of the lens is not however directly due to the contraction, but the tension of the ciliary ligament is lessened by this means, when the lens bulges by its own elasticity. The amount of accommodation is measured by the power of a lens necessary to produce the same result, and this, in the case of the emmetropic eye, is the reciprocal of the distance of the object from the eye measured in inches. The accommodation necessary to see an object 12 inches from the eye is $\frac{1}{12}$th, *i.e.* one twelfth of that necessary to see it an inch from the eye. The accommodation required to see an object 24 inches from the eye is called $\frac{1}{24}$. That to see it at an infinite distance is $\frac{1}{\text{infinity}}$ or nothing.

Presbyopia.—The power of accommodation is great in children, about $\frac{1}{2\frac{1}{2}}$; in young adults $\frac{1}{6}$. At thirty-five years it may be less than $\frac{1}{8}$, then objects at eight inches can no longer be seen distinctly. At forty-five it seldom exceeds $\frac{1}{12}$; at sixty $\frac{1}{24}$. It is agreed to call an eye presbyopic in which the accommodation falls short of $\frac{1}{8}$. For very minute work this amount is necessary.

Treatment.—The deficiency is to be made up by convex glasses. The strength of the convex glass required depends on the near point,[1] which is desired, together with the near point of unaided vision. Suppose a patient of thirty-eight years of age complains that he cannot do his work because he can only see distinctly at 12 inches; he requires to see at 8 inches to do his work. Subtract $\frac{1}{12}$ from $\frac{1}{8}$:—

$$\frac{1}{8}-\frac{1}{12}=\frac{3}{24}-\frac{2}{24}=\frac{1}{24}$$

$+\frac{1}{24}$ is the power of the glass required.

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[1] The nearest point of distinct vision is called the near point.

Suppose a person of sixty can no longer see, especially of an evening, you find he can see distinctly at 24 inches, but not nearer: he desires to see at 12 inches.

$$\frac{1}{12}-\frac{1}{24}=\frac{2}{24}-\frac{1}{24}=\frac{1}{24}$$

$+\frac{1}{24}$ is the power of the glass required.

It is important to remember that the weakest glasses, which enable a person to do his work, give him the longest range of accommodation. (The two examples show us that the same change of refractive power which moves the near point from 24 inches to 12, moves it only from 12 to 8 inches.) If the glasses used are too strong, especially in people who have very little accommodation left, they complain, because the slightest movement of the head or the work throws it out of focus. Such persons must be content to see at a greater distance only, or put up with this inconvenience.

If a person prefers to look through convex spectacles a little removed from the eyes, they are too strong.

The reason presbyopia first becomes manifest in the evening is that the pupil is dilated; the more dilated the pupil, the more indistinct objects become when they are slightly out of focus.[1]

Acuteness of Vision.—Stelling first proposed the method now always adopted, of measuring the acuteness of vision by a set of test type[2] placed 20 feet from the eye. Stelling's No. 20 should be seen at 20 feet; No. 30 at 30 feet, and so on. When No. 200 is seen at 20 feet, the acuteness of vision, usually written V, is said to equal $\frac{20}{200}$. $V=\frac{20}{20}$ means normal vision. $V=\frac{10}{200}$ is vision in which the largest letter only in the ordinary test type is seen at 10 feet.

Hypermetropia.—A condition of vision due to abnormal shortness of the antero-posterior diameter of the eyeball. Under these circumstances the focus of parallel rays is behind the retina, that is, distant objects are not distinctly seen when the eye is at rest. Persons with hypermetropic eyes require to shorten the focus of the eye: they do this by accommodating. Suppose the amount of accommodation required to see distant objects is

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[1] This is due to the fact that the indistinctness of an object out of focus is caused by a number of small images of the pupil being formed, instead of mere points of light; the larger the pupil, the larger these images.

[2] See Appendix.

$\frac{1}{12}$, to see objects at 12 inches another $\frac{1}{12}$ must be added. Hence the whole accommodation required is $\frac{2}{12} = \frac{1}{6}$. After twelve or fourteen years of age, the maintenance of $\frac{1}{6}$ of accommodation becomes painful, and 'weakness of sight' becomes apparent. It is often said that the power of the glass required to correct the hypermetropia, is the reciprocal of the age at which it commences to be felt. This is however a very rough guide, and depends much on the nature of the employment of the individual affected. In hypermetropia in youth the habit of accommodating usually becomes so strong, that the ciliary muscle never entirely relaxes unless under the influence of atropine.

To discover hypermetropia, generally written H, place the patient 20 feet from a set of test types, (or if the room is not large enough, 15 feet from an extended set having No. 15). Suppose he reads $\frac{20}{20}$, that is the last line, find the strongest convex glass with which it can still be read. This gives the measure of his manifest hypermetropia, generally written Hm. If the patient is under five and twenty, and more especially if the eyes have been used for close work, there will be a great deal more hypermetropia than is manifest. One or two drops of atropine solution (7) three times a day for a week, shading the eyes from strong light during the whole time, and prohibiting work, will relax the accommodation, and it will generally be found that a very much higher degree of H exists: this is called latent hypermetropia. Hypermetropia is exceedingly common, and may always be suspected when fatigue of the eyes is soon complained of during close work. There is still a foolish prejudice against the use of strong glasses, as they are called amongst the laity. At one time this was so great, even with surgeons, that hypermetropic persons were doomed to a life of dread and inactivity. Fortunately we now know better.

Treatment.—In young people it is best to discover the amount of the latent hypermetropia in the first instance. Convex glasses should be used constantly. Some surgeons think that glasses ought to be ordered at once to correct the whole H. As the acquired habit of accommodating strongly makes the wearing of such glasses very irksome, the more usual plan, and that always adopted by the author, is to give glasses which over correct the manifest hypermetropia a little, warning the patient at the same time that more powerful glasses will be required at intervals of some months, according to the amount of uncorrected latent hypermetropia. Suppose a patient with $Hm=\frac{1}{24}$ and $H=\frac{1}{10}$, glasses $+\frac{1}{20}$ will be worn with comfort. After six months the patient will complain perhaps that they are not so good as they were. Glasses $+\frac{1}{16}$ may now be given; in a year $+\frac{1}{12}$ can be used, and perhaps $+\frac{1}{10}$ will be required in two or three years. These will afterwards need to be added to for presbyopia. At forty-five or fifty years of age, there may be $\frac{1}{24}$ of presbyopia; then, in order to see near objects, the glasses required will be—

$$\frac{1}{10}+\frac{1}{24}, \text{ or } \frac{5}{50}+\frac{2}{50} \text{ nearly}=\frac{7}{50}=\frac{1}{9} \text{ nearly.}$$

Myopia (*Short Sight*).—In myopia the condition is the reverse of that in hypermetropia. The antero-posterior diameter of the eyeball is too long. By telling the patient to look inwards, and observing the outer side of the eyeball, it is seen to be strongly egg-shaped in extreme myopia. The elongation of the antero-posterior axis of the eye upon which myopia depends, as was first undoubtedly shown by Donders, is progressive, and except in very slight degrees progresses with age. The stronger the degree of myopia, the more liable it is to increase, especially between the ages of fifteen and twenty-five years. Considerable myopia is moreover attended with important pathological changes in the retina and choroid. The degree of myopia is measured by the power of the correcting glass required. Since, however, the patient can always neutralise a concave glass by accommodating, the weakest negative glass which gives the most perfect vision is the measure of the myopia. As a rule, however, we must mistrust all corrections which give less than $\frac{20}{20}$ths of vision, as there may be astigmatism or some other abnormality of the structures of the eye.

The causes of myopia are imperfectly understood. It is however most certainly hereditary, and is more common amongst educated than amongst uneducated people. Close work tends undoubtedly to increase it.

Treatment. — Concave glasses are needed. When the myopia does not exceed $\frac{1}{10}$th, and the patient is young and possesses good powers of accommodating, being able to read $\frac{20}{20}$ and small print at six inches from the eye with the glasses, the full correction should undoubtedly be given. The patient should be accustomed to wear the glasses, and enjoined never to bring work nearer than twelve inches to the eyes for any length of time, never to stoop over work or to read in the recumbent position, and never to work when the eyes feel fatigued. If these injunctions are not attended to, the myopia will increase, the retina will remain congested, and posterior staphyloma will be sooner or later produced.

When the power of accommodation becomes lessened, as with age, two pairs of glasses become necessary. In low degrees of myopia, glasses for near vision should be dispensed with. Even in young people with less than $\frac{1}{24}$th of myopia, glasses are only necessary for distant vision. When two pairs of glasses are required, it is a good plan to give a pair of spectacles for near objects, and a pair of folding eye-glasses to be put up in front of the spectacles when a clear view of distant objects is desirable. For instance, suppose a patient with myopia of $\frac{1}{8}$th. If $-\frac{1}{8}$th glasses are ordered, the patient will have to accommodate to the extent of $\frac{1}{12}$th to see objects at twelve inches. Never having been accustomed to accommodate at all, or only to accommodate slightly, this would be irksome or impossible, and if possible, undoubtedly injurious. Glasses of $-\frac{1}{8}+\frac{1}{12}=-\frac{1}{24}$th, will enable such a patient to see at twelve inches without accommodating. But this too is undesirable. It is well to exercise the accommodation; indeed if the patient converges he accommodates more or less. Suppose you give glasses $-\frac{1}{8}+\frac{1}{24}=-\frac{1}{12}$th; the patient now sees at twelve inches by accommodating to the extent of $\frac{1}{24}$th, but will require the addition of $-\frac{1}{24}$th to see objects at a distance. These should be given in folding frames, to be held up in front of the other glasses at pleasure.

In extreme myopia authorities are divided as to the proper course to pursue. Donders holds that we cannot safely correct the whole of the myopia by concave glasses. It is difficult to decide against so great an authority, yet if glasses give $\frac{20}{20}$, and the patient is young, with good accommodation, the writer cannot but agree with Mr. J. Couper, who has paid great attention to this subject, that such glasses should be given even though $-\frac{1}{5}$ is needed. The condition of the eyes, however, should be kept under observation. Even when less than $\frac{20}{20}$, say $\frac{20}{40}$ is obtained, if the retina is congested, the use of such glasses and the local abstraction of blood by the application of leeches, or better of the artificial leech (Heurtiloupe), often produces in a few weeks a marked improvement, so that even vision of $\frac{20}{20}$ with the glasses need not be despaired of.

The surgeon should always examine the eyes of myopic patients with the ophthalmoscope. The retina is often seen to be congested. If $V = \frac{20}{20}$ with appropriate glasses, nothing need be done except to enjoin rest to the eyes; if $V =$ less than $\frac{20}{20}$, blood should be abstracted locally, if the retina is congested, by the artificial leech or Heurteloupe. In extreme myopia, the outer side (inner in the inverted image) of the optic disc, usually exhibits a white crescent in which the choroid pigment is absent, and where the sclerotic is very much thinned, so that it may bulge outwards considerably (*posterior staphyloma*).[1] In such cases the sharpness of vision is usually much deteriorated, the choroid pigment is often absent in patches, and the retina may be detached in places; the field of vision is often limited, and of course there is no vision in parts of the field corresponding to detached portions of the retina.

The prognosis of such cases of extreme myopia is not good; the treatment is palliative at most, the use even of moderate glasses is perhaps a dangerous indulgence. In less damaged eyes myopia is less likely to progress when glasses are used; sometimes it ceases to increase after twenty-five or thirty-five years; the patient will then probably retain whatever vision is left, if the eyes are not overworked. I have seen an old lady of eighty with fairly good vision, but with very considerable posterior staphyloma. It is always well to advise persons with extreme myopia to adopt some calling where close application and continued exertion of the eyes at near work is not needed. A strongly myopic eye is always a feeble organ at best.

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[1] Plates i. and iv., figs. 1 and 7.

There can be no doubt that myopia is greatly increased, where it exists only in a slight degree, by children in schools working in ill-lighted rooms at low desks; perhaps it may even be produced in this manner.

Muscæ.—Black specks and transparent curled band-like spectra, which appear in the field of vision, especially in myopic persons. These usually appear to be slowly falling, and can be made to rise again by movements of the head;

they are chiefly seen when a white surface is looked at, and are especially distinct when the pupil is contracted. The appearance is due to minute organic elements in the vitreous, the shadows of which are cast upon the retina. The cause is permanent, but the specks may disappear with a dilated pupil, because the shadows are then larger and more diffused. The existence of these specks is usually a source of great anxiety to the patient, but they are never serious, and have probably existed for years, perhaps from birth, but have not been noticed. After the attention has been called to them, they are, however, very annoying; they become very distinct when the retina is more irritable than usual, as after illness and during fatigue, or any disturbance of the alimentary canal.

Treatment.—The patient must be advised to disregard them, and assured that they are harmless and will lead to no further trouble. Patients rarely give up fretting about them, and are very liable to fall into the hands of men who see, or pretend to see, great danger in the symptoms. Nothing can be seen with the ophthalmoscope, owing to the small size of the bodies producing the spectra. The surgeon should, however, carefully examine the eye, and use his best endeavours to reassure his patient; explaining the cause of the phenomenon, whenever this is likely to be understood.

CHAPTER VI.

REFRACTION—(*continued*).

Astigmatism — Stenopaic Slit — Jarval Optometer — Determination of Refraction with the Ophthalmoscope — Difference of Refraction in the two Eyes — Mixed Astigmatism — Irregular Astigmatism — Conical Cornea.

Astigmatism.—A condition in which a point does not appear as a point, but as if drawn out into a line (hence the term *a*, without, *στίγμα*, a point or spot). It is due to the curvature of the cornea not being the same in every direction. In every eye, probably, there is a slightly greater curvature of the vertical than of the horizontal meridian of the cornea; it is only when the optical effect of this difference becomes perceptible that we consider astigmatism exists. Suppose a case in which the horizontal meridian of the cornea is so curved that the eye is emetropic in that meridian; the vertical meridian will be myopic. If this myopia is greater than $\frac{1}{96}$, it will be apparent in the difference in the distinctness of vertical and horizontal lines. Suppose a considerable degree, say $\frac{1}{24}$ of myopia in the vertical meridian, all vertical lines will appear longer and all horizontal lines broader than they really are; hence narrow horizontal lines appear very faint or are not seen at all, whilst the vertical lines remain distinct, the increase in their length being unobserved. A fan of equal narrow black rays, placed at a distance, appears to an astigmatic person as if some of the rays were broader and fainter than the others. The lines on a sheet of music paper become indistinct at different distances when they are held vertically or horizontally. If a weak cylindrical glass is held before an astigmatic eye and turned round, vision will be better with the axis in one direction, and worse with it at right angles to this direction. Whenever a person persistently misreads certain letters of the test types, when vision is better with spectacles placed at an angle in front of the eyes than with the same glasses held parallel, and whenever a patient sees better with a cylindrical glass with its axis held in one direction than in another, astigmatism may be suspected.

The eyes of astigmatic persons are very liable to fatigue; the retina is usually congested and the disc often has a peculiar woolly look, an almost cloudy appearance.[1] Vision is usually much impaired when any considerable degree of astigmatism exists so that $\frac{20}{40}$ may be the best result attainable with suitable glasses; and even if this can be gained we may usually congratulate our patient on the result, when the degree of ametropia is considerable. The constant use of suitable glasses in astigmatism undoubtedly removes the asthenopia and congestion of the optic disc and is the greatest boon to the patient, often rendering the defective eyesight of the astigmatic patient as perfect as that of a normal eye. I have repeatedly seen vision improved from $\frac{20}{40}$ to $\frac{20}{20}$ in a few weeks by simply wearing correcting glasses. The measurement of astigmatism requires considerable patience; it may be effected by the stenopaic slit, the Jarval optometer, by the trial of cylinder glasses, or by the ophthalmoscope.

The Stenopaic Slit is a narrow slit in a brass disc. If the patient sees $\frac{20}{20}$ by looking through the slit placed horizontally, but does not read $\frac{20}{20}$ without the slit, the horizontal meridian is probably emmetropic, and therefore needs no correction; it may however, be hypermetropic. The vertical meridian is probably myopic; a weak spherical concave glass, -36, placed behind the slit enables the patient to read $\frac{20}{20}$ with the slit vertical. This shows that there is myopic astigmatism of $\frac{1}{36}$ or less, but does not give its measure, since a weaker glass may equally answer. Concave cylindrical glasses of less than $\frac{1}{30}$ with the axis horizontal, or a little inclined one side or other of the horizontal, should now be tried, and if the patient reads $\frac{20}{20}$ the astigmatism has been corrected.

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[1] Plate i. fig 2.

The patient may be strongly myopic, say $\frac{1}{10}$ of myopia exists; no glass gives $\frac{20}{20}$ but with the slit $-\frac{1}{10}$ gives $\frac{20}{20}$ when the slit is horizontal; $-\frac{1}{8}$ gives $\frac{20}{20}$ with the slit vertical; then $\frac{1}{8}-\frac{1}{10}=\frac{1}{40}$ is the measure of the astigmatism. The astigmatism will then be corrected by a $-\frac{1}{40}$ cylinder axis horizontal, and the myopia by a $-\frac{1}{10}$ spherical lens. In a young subject such a combination may be ordered; if the accommodation is weak or the patient aged, the spherical glass must be reduced in power according to the rules given under myopia, but the full correction for the astigmatism must be given. Hypermetropic astigmatism can be measured in the same manner, substituting convex for concave glasses.

It is better always to use atropine (as in hypermetropia) before the determination of astigmatism is entered upon; with exceedingly sensitive people it is absolutely essential, as they are continually accommodating, so as to get a distinct picture first of lines in one direction, and then in another. In hypermetropic astigmatism the use of atropine cannot be dispensed with, and the same is true with regard to myopic astigmatism, unless distant objects are employed, and these are incapable of being used unless the myopia is corrected first, and then only when the degree of astigmatism is not large.

The Javal Optometer is an instrument with a series of cylindrical glasses arranged in discs of metal and capable of being brought in turn before the eye. A card dial with very fine radiating lines is looked at through a strongly convex glass, generally $+\frac{1}{6}$, all the cylinders being turned aside; an emmetropic non-astigmatic eye sees all the lines on the dial equally well when it is 6 inches in front of the lens. If myopic astigmatism exist, the horizontal lines will only become distinct when the disc is brought nearer. Suppose the horizontal lines become distinct at 5 inches, then taking the differences of the reciprocals of the distances, $\frac{1}{5}-\frac{1}{6}=\frac{1}{30}$, gives the amount of myopic astigmatism; but placing a $-\frac{1}{30}$ cylindrical glass with its axis horizontal, all the lines should be equally distinct at 6 inches. But in the Javal optometer we have only convex cylinders; the $+\frac{1}{30}$ with its axis vertical has, however, the same effect, except that all the lines are seen equally well at 5 inches instead of 6; indeed we have rendered all the meridians equally myopic, and must, of course, allow for this in making our final correction. A great many trials are generally necessary, and the eye must be thoroughly under the influence of atropine to ensure success.

Much time is usually saved by using the ophthalmoscope, to ascertain approximately the degree of astigmatism, but this requires considerable practice; the method will be explained in the next article.

Determination of the Refractive Condition of the Eye by the Ophthalmoscope.—Parallel rays of light come to a focus on the retina of an emmetropic eye; therefore, by a well known optical law, rays from any point of the same retina become parallel on leaving the eye. When the head of the observer and the ophthalmoscope ocular are drawn gently back from the eye of the patient, if it is emmetropic the optic disc remains apparently the same size; it neither increases nor diminishes in magnitude or brightness. If the ocular glass be discarded and the ophthalmoscope mirror without any glass behind it be brought close up to the patient's face, the retina will be seen distinctly, and the image seen is direct, that is, it is not reversed or inverted. It is not a real but a virtual image apparently considerably behind the patient's retina, where there are of course no rays of light. This image is only seen when the observer's eye as well as that of the patient is emmetropic, and at once disappears if the observer accommodate for a near point, or if he places a convex glass behind the opening in the mirror of the ophthalmoscope.

It is useful to remember that the direct image of the retina of an emmetropic eye is distinctly seen by an emetropic eye only, that that of a myopic eye is seen by an observer having the corresponding degree of hypermetropia, and that of a hypermetropic eye by one with corresponding myopia, or by accommodating to a degree commensurate with the hypermetropia of the patient. The use of convex glasses behind the ophthalmoscope produces artificial myopia, and that of a concave one artificial hypermetropia in the observer.

The direct image of the retina of a hypermetropic eye is consequently far more easily seen than that of an emmetropic eye, because rays of light coming from a hypermetropic retina diverge after they leave the eye; hence they are like rays coming from a comparatively near object. The observer accommodates to an extent corresponding to the hypermetropia of the patient. To measure the degree of hypermetropia, put a series of convex glasses behind the opening in the mirror and entirely relax your own accommodation; this is done by looking vacantly into the distance and keeping the axes of the two eyes parallel; it only requires practice. If the mirror be an inch and a half or two inches only from the patient's eye, the glass which gives the most distinct image of the details of the retina is the measure of the patient's hypermetropia. Much practice is required to attain accuracy by this method but it is most useful, and with children is the only means of attaining the measure of the hypermetropia. Wecker's ophthalmoscope as modified by Mr. J. Couper is by far the best instrument for this kind of investigation; a series of glasses are carried in discs which fit behind the mirror, and which can be brought in turn in front of the opening. In Mr. Couper's most improved instrument, the mirror can be turned so that the glasses are always kept parallel with the lens system of the eye, an important point in the study of astigmatism. If myopia exist, the direct image cannot be seen without concave glasses are placed behind the opening in the mirror of the ophthalmoscope, and the inverted image may be seen without the ocular glass by removing the mirror from the eye of the patient to a distance corresponding to 12 or 15 inches more than the amount of myopia. The rays from an object 12 inches from the eye of a person with myopia of $\frac{1}{12}$ fall in a point on the retina; hence rays from the retina of such an eye fall into focus 12 inches in front of the eye. A real picture, inverted and reversed, is therefore formed in the air at this point, and may be seen by the eye of an observer correctly focussed for this point. The real inverted image seen in this way may be readily distinguished from the virtual erect image seen when the patient is hypermetropic. The former appears to move in the reverse direction when the surgeon moves his head; the latter appears to move in the same direction as the head of the observer when he moves.

In observing the optic disc with the ophthalmoscope and ocular glass, it will be seen that the apparent size of the disc is diminished in hypermetropia and increased in myopia, by withdrawing the ocular and the head of the observer from the eye of the patient.

The disc always appears comparatively small in a myopic and large in a hypermetropic eye, when the inverted image is observed with the ophthalmic ocular.

When astigmatism exists, the optic disc becomes elongated in the myopic, and diminished in the hypermetropic meridian, when the head of the observer and the ocular lens are withdrawn from the eye of the patient. In order to diagnose astigmatism in this way, the centre of the ocular lens and the cornea of the patient should be in the line of vision, and the surface of the ocular lens must be kept at right angles to it. It is then easy with practice to determine the existence of astigmatism with certainty.

Difference of Refractive Power in the two Eyes.—It often happens that there is a very great difference in the refractive power of the two eyes. When this is the case it is generally best to correct the least defective eye, and to leave the other without correction; if one eye is emmetropic and the other strongly myopic or hypermetropic, it is usually best not to correct the faulty eye with spectacles. When however there is not more than $\frac{1}{24}$th of myopia or hypermetropia, and whenever there is asthenopia from astigmatism, the faulty eye should always be corrected with suitable glasses.

The two eyes should be corrected separately whenever the difference between them does not exceed $\frac{1}{24}$. Even when the difference is greater, the attempt to correct the two may be made, but it will be found generally that the patient cannot use them comfortably together. In young patients I have often seen binocular vision obtained when the eyes have differed to the extent of $\frac{1}{16}$. Perhaps the most satisfactory rule is to give glasses suitable for the best eye except in cases of astigmatism, which should always be separately corrected in each eye. If the patient complains of double vision or fatigue when wearing the spectacles, it will be better to put a plain glass into the spectacle of the least normal eye. No general rule can however be laid down; each case must be treated by a careful consideration of all the conditions present.

Mixed Astigmatism.—When a vertical meridian of the cornea is myopic and a horizontal meridian is hypermetropic, the term mixed astigmatism is applied; some meridian is then emmetropic between them. This condition requires a minus cylinder with its axis horizontal, and a plus cylinder with its axis vertical.

Irregular Astigmatism.—Sometimes the refractive power of the eye is so irregular that it cannot be corrected by glasses. A portion of the lens or cornea may be irregular in form or refractive power; there is no means of correcting this abnormality except it arise from conical cornea.

Conical Cornea.—The cornea sometimes assumes a conical form by bulging in its centre. The cause of this affection is unknown. All objects become exceedingly confused and indistinct. In advanced cases the cornea can easily be seen to be conical by viewing it in profile. The reflection of the light from a window on the cornea is the most delicate test; peculiar illuminated curves (parabolas) appear on its surface, and the reflections of straight lines assume similar curves. With the ophthalmoscope mirror alone, either the centre or the periphery of the fundus will appear dark according to the distance of the mirror from the patient's eye.

Treatment.—Removing a circular disc from the apex of the cone of the cornea with the small trephine about 3 mm. in diameter, invented by Mr. Bowman for the purpose, often produces the most brilliant results. The cornea should not be perforated but its outer layers down to the inner elastic coat should be removed, and this is done by stripping the layers of the cornea cut through by the trephine off the inner elastic layer with a fine pair of iris forceps. If the cornea is accidentally perforated by the trephine in a part of its circumference, no great harm need be feared, but great care is needed not to wound the lens. The operation requires very delicate manipulation. The cicatrix formed by the healing of the wound draws the cornea together, and produces flattening of the cone. The cicatrix is often barely visible. It may be necessary to make a small iridectomy, in order that the patient may not look through the cicatrix some months after the primary operation. Unless an operation is performed the conicity gradually increases. Sometimes the operation produces results which are little short of miraculous.

CHAPTER VII.

GLASSES.

Testing the Refractive Power of Glasses—Focal Length of Glasses—Trial Glasses—Spectacles—Protective Spectacles—Correcting Spectacles—Periscopic and Pantascopic Spectacles—The Adjustment of Spectacle Lenses—Decentralised Glasses.

Testing of the Refractive Power of Glasses.—In practice this is accomplished by neutralising a convex by a concave glass. When the glasses are held together they should not alter the appearance of distant objects; if two parallel lines are ruled and looked at, partly through and partly over the glasses, they should not appear further apart or nearer together where they are seen through the glasses. If their distance from each other appears less through the glasses, the concave glass is too strong; if greater, the convex glass is too strong.

The absolute measurement of the focal length of a lens can only be determined for a convex lens. It can be most accurately done by Professor

Donder's phakometer. The principle on which this is effected depends upon the fact that the focal length of a lens is equal to half the distance between an object or its image and the lens, when the lens is placed exactly midway between them.

The Focal Length of Glasses is usually expressed in French inches; efforts are, however, being made to adopt the metre as a standard of measurement, but, owing to the practical difficulties of altering all the existing test glasses and instruments for constructing spectacles it will probably be long before it is accomplished.

Trial Glasses.—A case of trial glasses is absolutely essential to the ophthalmic surgeon. The usual boxes contain twenty-eight pairs of convex and the same number of concave glasses. The focal lengths of these glasses are usually: 2, $2\frac{1}{4}$, $2\frac{1}{2}$, 3, $3\frac{1}{2}$, 4, $4\frac{1}{2}$, 5, $5\frac{1}{2}$, 6, 7, 8, 9, 10, 12, 14, 16, 18, 20, 24, 28, 36, 40, 48, 60, 72, 100 inches.

Glasses of a longer focal length than 36 inches may, however, be dispensed with, and the differences between the higher powers even in the most perfect boxes is too great. Mr. Couper suggests a difference of $\frac{1}{96}$ between the reciprocals of the focal length of each pair of glasses; this requires

48 pairs of convex and the same number of concave glasses, besides introducing a number of very inconvenient fractions of an inch, whilst every advantage except a uniform difference may be attained by making the difference $\frac{1}{4}$ of an inch instead of half an inch between the successive glasses from 5 to 2 inches focal length. These are useful in aphakia after cataract operations, but are rarely required in ametropia, since in the higher degrees of ametropia it is seldom that the sharpness of vision is sufficient to detect the difference between glasses having a difference of $\frac{1}{48}$. In the glasses above 9 inches, a difference of half an inch between each successive pair might also be desirable but is certainly not essential for obtaining very excellent results.

Cylindrical glasses are also necessary. There are usually about 14 pairs of convex and a similar number of concave glasses. The focal lengths are generally 80, 50, 36, 30, 24, 20, 18, 16, 14, 10, 9, 8, 7, 6 inches, and these are the most useful. Twelve prisms are also useful with angles of 3°, 4°, 5°, 6°, 7°, 8°, 9°, 10°, 12°, 14°, 16°, 18°.

Several pairs of frames for holding the glasses are required; one pair with two grooves, for holding both a spherical and cylindrical glass before each eye, is likewise essential.

Spectacles are of two kinds, those which are used for protecting the eyes from bright lights and foreign bodies, and those for the correction of errors of refraction.

Protective Spectacles should be made with neutral tint glasses, which should be large and shaped like oval watch glasses so that they protect the eyes on all sides, and are sufficiently removed from them not to irritate them by becoming heated, for dark glasses are very liable to become much heated in the sun or other sources of heat, especially when they are very dark. Blue and green glasses are far less suitable than neutral tint to protect an irritable retina. All protecting glasses are liable to distort objects owing to inequalities of curvature and faults in the glass; this is a great defect, such glasses should therefore always be very carefully selected. The depth of tint must be regulated by the amount of irritability or the intensity of the light.

Correcting Spectacles are usually made with concave or convex glasses, and of crown glass. Flint glass is harder, but except for glasses with a long focus it is unsuitable, as it does not bring the rays of different colours to so nearly the same focus as crown glass, hence it is more liable to produce coloured fringes around objects. Such glasses are often called pebbles by opticians. Rock crystal is still less suitable than flint glass, and is probably never used.

Meniscus lenses or lenses with one convex and one concave surface are used for *periscopic* spectacles; such glasses enable the wearer to look around him better without moving his head. If the convex curvature is greatest in periscopic glasses, they are like convex glasses in their action and *vice versâ*. The objection to such glasses is their greater weight and expense; they are very suitable, however, for low degrees of hypermetropia. The power of a periscopic glass is equal to the difference of the reciprocals of the focal lengths of its curves. Suppose the focus of the convex curve is 15 inches and that of the concave is 30 inches, the glass has a refractive power equal to $\frac{1}{15}-\frac{1}{30}=\frac{1}{30}$.

In hypermetropic astigmatism the principle of periscopic glasses may be usefully adopted by making the spherical curve correct the flattest meridian of the cornea, and using a concave cylinder to reduce the refractive power for the less hypermetropic meridian.

Pantascopic Spectacles are glasses with a double focus, the upper half of each glass is of a lower convex or higher concave curvature than the lower half, so that the wearer sees distant objects by looking through the upper half, or near objects by looking through the lower half, of his glasses. They are suitable for ametropic patients with presbyopia, but are seldom employed, as most persons prefer either to change their spectacles or to supplement them with a double eye-glass held in front of them.

The Adjustment of the Glasses in their frames is of great importance. The centre of the glass is usually ordered to be placed directly over the centre of the pupil; much advantage will, however, be usually found in placing the centre of convex glasses somewhat nearer together, and concave glasses somewhat further apart than the centres of the pupils, as there is usually some insufficiency of the internal recti. The amount of decentralisation, must be carefully tested in each case by the comfort with which the glasses are used, as any irregular decentralisation will cause the patient to throw aside the glasses as unsuitable. In many cases much of the success of the surgeon will depend upon the judgment he uses in ordering decentralisation of the spectacle glasses, and the care with which his orders are obeyed by the optician.

CHAPTER VIII.

AFFECTIONS OF THE MUSCLES OF THE EYE.

Strabismus—Division of the Rectus Tendon—Diplopia—Insufficiency of the Internal Recti—Nystagmus.

Strabismus, or squinting, must be regarded rather as a symptom than as a disease, but as it is a symptom which the ophthalmic surgeon is often called upon to treat, it is convenient to consider its various forms under one head. The movements of the eyeballs are connected physiologically with the power of binocular vision. When we fix the eyes upon an object, its image should fall upon the yellow spot of either eye; the images of all surrounding objects situated in one plane then fall on corresponding parts of the two retinæ. Under these circumstances we see a single picture, which in the case of objects sufficiently large or near is stereoscopic, or has the appearance of solidity and depth.

Under any other circumstances either objects appear double, the double images are disregarded, or one image is neglected. When we fix our eyes upon a distant object near objects appear double, and when we fix them on a near object distant objects appear double; since in these cases the double images are out of focus and faint we disregard them. A very simple experiment will demonstrate this. Fix your eyes upon a distant object (a gas lamp answers best) and hold up your finger a foot or more from your eyes, you see a double image of the finger; look steadily at your finger and you see a double image of the lamp. If the lamp is at a considerable distance it will be found necessary to use an effort to see the lamp at all, so strong is our tendency to disregard such double images.

When we look at near objects we do two things, we converge the axes of the eyes by using the internal recti, and then accommodate for a near point; hence convergence and accommodation are connected physiologically, and this connection is so strong that myopic persons accommodate when they converge, although the accommodation is a positive impediment to vision; for instance, a person with myopia of $\frac{1}{12}$ sees distinctly with either eye objects 12 inches in front of it; but if such a person uses both eyes he converges and accommodates. The object is now only seen distinctly at eight or even six inches from the eyes; this is probably one of the causes of progressive myopia, increased convergence stimulating increased accommodation, and increased accommodation causing a still further degree of convergence. As this gives rise to pain and fatigue, binocular vision is liable to be dispensed with, especially if one eye gives less distinct images than the other. The more defective eye is then drawn out of the way by the external rectus acting against a fatigued internal rectus, and divergent squint is produced.

The opposite condition arises from hypermetropia. In hypermetropia accommodation is necessary for distant objects, and convergence, or a tendency to convergence, is the result. If binocular vision exist, the hypermetrope constantly endeavours to form a single picture; use becomes second nature and the movements of the eyes correspond. If strong accommodation is required, however, owing to the existence of a high degree of hypermetropia, this is impossible, so strong is the tendency to convergence. The patient will then sacrifice distinct vision, by failing to accommodate, rather than produce double images. There is, therefore, no squint in this case. But if the images produced on one retina are fainter and less defined than those on the other, they are disregarded; convergence is then allowed to occur commensurate with the amount of accommodation; the best eye is then directed to the object, the more defective one being directed strongly inwards.

One or other of the above conditions cause quite 90 per cent. of the cases of squint seen by the surgeon. As hypermetropia is far commoner than high degrees of myopia, convergent is far more frequent than divergent squint.

In hypermetropia the axes of the eyes frequently diverge slightly; this is not, however, divergent strabismus, it is due to the fact that the yellow spot usually lies further from the axis of the eyeball in hypermetropic than in emetropic or myopic persons; hence when the optic axis of the eye (the line joining the yellow spot with the centre of the cornea) is directed towards a distant object, the axis of the eyeball looks outwards more than in the normal eye, giving rise to the appearance of divergent squint.

Strabismus is sometimes due to paralysis of one or more of the muscles of the eyeball; the history of the case and the concomitant symptoms must then be our guide to its diagnosis. Tumours in the orbit may likewise produce squint.

In cases where the deviation of the squinting eye is not very great, there may be some doubt as to which is the affected eye; in such cases the patient should be directed to look at the top of the surgeon's finger whilst he alternately shades each eye with a piece of card or a small book. The eye that squints moves when the other is covered, since the patient now directs it to the object; the other eye does not move when the squinting eye is covered.

The vision of the squinting eye is usually less perfect than that of the other, and it undoubtedly degenerates if the deviation is allowed to remain uncorrected. It may be from disuse; hence it is advisable to operate on young children even if of two years old, as there is then a better chance of establishing binocular vision by correcting the ametropia. According to Von Graefe, about 50 per cent. of the cases operated on attain binocular vision. Donders, however, thinks this too high an estimate.. Convergent squint has a tendency to lessen as life advances.

Treatment.—Convergent squint is the most common and the most easily treated. When the squint is only manifested in looking at near objects, it is usually easily cured by appropriate glasses; correct the hypermetropia and the squint will disappear.

When the squint is permanent it is necessary to divide the internal rectus of one or both eyes. The amount of the convergence must be the guide as to whether one or both internal recti require division; the fact that only one eye squints has nothing to do with the decision. After the division of both recti, the absolute or relative success of the operation will depend very much upon the patient's getting binocular vision with appropriate glasses; if this cannot be obtained the surgeon should direct the more defective eye to be used separately for a short time every day, as the patient then learns to keep the eyes directed towards the same point. Unless this is done the patient will have nothing to guide him in keeping the two eyes directed towards the same point. Even without binocular vision, if the position of the eye is satisfactory after the operation, the deformity is in general removed and seldom returns. Sometimes, however, an external squint is produced, and it may be necessary to readjust the eye by the operation described at page 93.

In divergent squint the myopia must be first corrected by glasses; if the squint still persist, the external rectus of the eye which deviates outwards must be divided; the operation is, however, frequently unsuccessful. It requires great judgment to decide when the operation should be done and when left undone, and there is great difficulty in laying down any rules for the guidance of the surgeon. If the deviation is very considerable the operation should be performed, especially if binocular vision can be hoped for by the use of glasses.

The Operation of Dividing the Rectus Tendon.—The operation usually selected at Moorfields was devised by Mr. Critchett. It is performed in the following manner:—When the tendon of the internal rectus is to be divided, the eyelids having been fixed by a stop speculum, a fold of conjunctiva and subconjunctival tissue must be picked up with a pair of conjunctiva forceps about two lines from the edge of the cornea and midway between the insertion of the internal and inferior rectus, and a snip made with a pair of strabismus scissors. When one of the other tendons requires division the position of this incision must of course be modified. A blunt hook is now passed through the opening, with its end resting on the sclerotic, and slipped under the tendon of the rectus. The eye is now rotated outwards by the hook, and the scissors are passed into the wound under the hook. The tendon is divided close to the sclerotic by small snips with the scissors. The scissors having been withdrawn, a search should be made with the hook to discover if the whole tendon has been divided. There is usually a good deal of ecchymosis into the subconjunctival tissue. After the operation the eye should be bathed frequently with cold or lukewarm water for three or four days, and if the full effect of the division is required, the patient should be taught to look outwards with the eye on which the operation has been done, so that the adhesion of the tendon to the sclerotic may take place far back.

It is better not to tie up the eye after the operation.

The tendons of the muscles of the eye are invested by a layer of fascia called Tenon's capsule. The more extensively this is divided, the greater will be the effect of the operation. It requires both experience and judgment to decide how much will be required to be divided in any given case. Sometimes after the division of the conjunctiva the subconjunctival layer of Tenon's capsule will be found not to have been divided; if this is the case it must be picked up separately and divided.

In Liebrich's operation, this layer of Tenon's capsule is left undivided in the first incision, and the conjunctiva is separated from it as far as the caruncle, and widely upwards; little or no bleeding takes place during this stage of the operation. Tenon's capsule is next picked up and divided, and the operation completed in the usual manner. This operation is said by some to prevent the drawing in of the caruncle which is otherwise liable to occur. Some surgeons put a single fine suture into the external wound in the conjunctiva; this is, however, hardly necessary. It is said to render the scar less apparent; it is usually, however, scarcely visible if no suture is used. The external opening should only be large enough to admit the hook and scissors.

Diplopia.—Objects appear double from the axes of the eyes being directed to different points. This affection is therefore dependent on usually very slight strabismus. Very frequently it arises from paralysis, or partial paralysis, of some of the muscles; it is frequently syphilitic in its origin.

Treatment.—When syphilitic, or when syphilis may be suspected, iodide of potassium, bichloride of mercury, or both may be prescribed. It is best to cover the eye which gives the false image; that is, the image which does not appear in its proper position. The affection is usually temporary; if it become permanent the question of the advisability of dividing the tendon of one or more of the recti may arise, but operations of this kind are not generally attended with very great success.

Insufficiency of the Internal Recti.—This affection is usually connected with considerable myopia, but may occur in emetropia or even in hypermetropic eyes. The patient complains of great fatigue and a sensation of heat in the eye as soon as he attempts near work. Reading and writing sometimes become impossible from this cause, unless one eye be covered or shut.

Treatment.—The error of refraction must be corrected and the glasses should be decentralised; that is, the centres of convex glasses should be placed nearer to each other than the pupils of the eyes, and concave ones placed further apart, so that they act as prisms with their bases inwards. Dr. Liebrich constantly does this with both convex and concave glasses with the best results, sometimes to the extent of a quarter of an inch in each glass. If this do not succeed it is perhaps best to cover one eye for near work; the external rectus of one or both eyes may be divided, but the results of this operation are such that it should be undertaken with great caution. The question of treatment is very intricate. The reader should consult Donders, Soelberg, Wells, and others on this subject.

Adjustment of the Eyeball by a Plastic Operation. This is sometimes necessary in external strabismus, when it is caused by total inefficiency of the internal rectus, especially when the strabismus arises from a former operation for internal squint. A portion of the conjunctiva and subconjunctival tissue must be removed from the inner side of the sclerotic and the internal rectus tendon divided; the outer and inner edges of the wound are then brought together by one or two fine silk sutures, which should pass through the tendon of the internal rectus; the size of the piece of conjunctiva to be removed must depend upon the amount of deviation outwards. The internal rectus is drawn forward in this operation when it has been allowed to slip too far back in a previous operation for internal squint.

Nystagmus.—Unsteadiness of the eyeball from spasmodic action of the muscles. It generally appears in infancy, and the eye affected is usually imperfect in other respects.

Treatment.—If accompanied by squint, tenotomy should be performed for the latter affection; perhaps the eyeball may then become steadier. An attempt should be made to correct errors of refraction, but there is no known satisfactory treatment for nystagmus. It sometimes improves as the patient grows up. Division of the tendons of the affected muscles and their antagonists has been recommended.

CHAPTER IX.

AFFECTIONS OF THE IRIS, CILIARY REGION, CHOROID AND VITREOUS.

Paralysis of the Iris and Ciliary Muscles—Spasm—Tension of the Eyeball—Iritis—Iridectomy — Serous Iritis — Irido-Choroiditis —Cyclitis—Sympathetic Ophthalmia—Panophthalmitis.

Paralysis of the Iris and Ciliary Muscle is not uncommon with paralysis of the third nerve, and is frequently syphilitic in its origin; the marked dilatation of the pupil and immobility of the iris, together with the loss of power of distinguishing near objects, indicate this condition. If vision is restored to its normal condition by a convex glass and a circular stenopaic opening, the diagnosis is complete.

A special form of paresis of the ciliary muscle and more or less dilatation of the pupil occurs after diphtheritic inflammation of the throat. It is usually accompanied by some paralysis of the soft palate, but the mobility of the eyeball is not affected. Sometimes this condition lasts several months.

Treatment.—If there is no manifest cause, syphilis may be suspected and iodide of potassium should be administered. In diphtheritic paresis, tonics, especially iron, are indicated. In all cases the vision must be corrected by suitable glasses if hypermetropia exist, and an addition must be made for near work. In emmetropes $+\frac{1}{16}$, or even $+\frac{1}{12}$ may be required. In hypermetropes a more powerful glass will be needed; suppose $\frac{1}{16}$ of hypermetropia exists, $\frac{1}{16}+\frac{1}{16}=\frac{1}{8}$, and a glass of 8 inches focus will be required for near work. As recovery takes place, the strength of the glasses will require to be gradually reduced to $\frac{1}{16}$. The application of small discs of gelatine impregnated with a solution of physostigmatine beneath the lower eyelid, or the dropping of a solution of physostigmatine into the eye once or twice a day, has been found useful in restoring activity. If the quantity applied is too large, it will possibly produce spasm and pain.

Spasm of the Ciliary Muscle.—Tonic and painless spasm of the ciliary muscle is not uncommon both in hypermetropes and myopes. In the former, as has been already stated, it is due to the constant effort to see near objects; in the latter, to the increased convergence of the eyes, of which it is the physiological accompaniment. Painful spasm, or cramp on the attempt to look at near objects, is very rare.

Treatment.—Atropine to paralyse the muscle must be persevered with until there is complete relaxation. This will be known to have taken place when the myope sees at his far point, and in hypermetropia, when the strength of a convex glass increases no longer with each few days. The refraction must then be corrected, and if the proper glasses are worn the spasm will not return. Astigmatism is a frequent cause ot ciliary spasm.

Tension of the Eyeball.—The tension of the eyeball is subject to only very small variations in health, although it differs somewhat in different people. As increased tension is a most important symptom in many of the following affections of the eye, it behoves the student to make himself familiar with the normal condition.

The tension of the eyeball is determined by telling the patient to look slightly downwards and to close the lids gently. The surgeon places two fingers upon the upper lid and determines the tension of the eyeball, just as he would determine the existence of fluid by fluctuation. In extreme tension the eyeball feels of stony hardness and will not dimple under firm pressure with the finger. This is spoken of as T_3. T_n means normal tension; T_1, slight increase; T_2 considerable increase. A soft eye is said to have minus tension $-T$, the degrees of softness being indicated like those of hardness; extreme softness is $-T_3$. If the patient uses his orbicularis strongly, it gives an apparent increase of tension; this must be guarded against. A prominent eye may also give a false sensation of increased tension.

Iritis.—Inflammation of the iris is far the most frequent inflammation occurring in the deep structures of the eye. The cornea is surrounded by a pink zone of sclerotic vessels; these are, however, sometimes masked by the conjunctival vessels being also congested. There is often great pain over the brow and temple, vision becomes misty, there is intolerance of light, and often increased tension of the eyeball.

The best marks of iritis in its earlier stage are alteration of the colour of the iris, with occasional slight turbidity of the aqueous humour and inactivity, when it is alternately shaded and exposed to light. In the later stages the adhesions the iris contracts with the capsule of the lens, and in the so-called syphilitic form, the pellets of buff-coloured lymph which occur on the margin of the pupil, are diagnostic. In suppurative iritis pus soon collects in the anterior chamber, and blood is sometimes effused with it.

Iritis is very frequently syphilitic in its origin; but although the collection of pellets of lymph is generally a sign that the disease is syphilitic, yet it cannot be said that they always occur in syphilitic iritis, or that they never occur when the disease is not of syphilitic origin. No diagnosis can be given which defines the difference absolutely between the syphilitic, rheumatic and idiopathic affections. When the disease occurs in young children, it will be usually found that other symptoms of inherited syphilis exist, and it rarely or ever occurs in them except when of a specific origin. In adults syphilis is undoubtedly the most frequent cause of iritis; it may occur either with the secondary rash or it may make its appearance as one of the latest sequelæ of syphilis.

Iritis occurs also in rheumatic subjects; it arises from wounds, or it may occur idiopathically. No age is exempt from it; even very old people suffer from a chronic form, which also affects the choroid. Except when syphilitic, the disease is very liable to recur, especially if neglected, and if it recur repeatedly it is sure sooner or later to spread to the choroid and retina, and to produce blindness and secondary cataract. (*See* Irido-choroiditis.)

Treatment.—The syphilitic form of the disease commonly succumbs to the usual anti-syphilitics, but the other forms are often much more obstinate. In all forms of iritis guttæ atropiæ (7 or 8) should be used frequently, as it is of the utmost importance to keep the pupil dilated, both because it relieves tension of the eyeball, and because it prevents adhesions forming between the iris and the capsule of the lens, or between the opposite margins of the pupil which might otherwise become entirely blocked up with lymph. As has already been stated, some people cannot stand the application of atropine; it gives rise in them to great heat and congestion of the eye. Fortunately these cases are rare. In such cases ext. belladonnæ should be rubbed into the temple and brow, either alone or mixed with mercurial ointment. The eyes must be carefully shaded from light, or what is better still in the acute form, the patient should be kept in a darkened room. Opium should be given to eliminate pain; it undoubtedly exercises a most beneficial influence. In very acute cases leeches applied to the temple are undoubtedly useful. Mercury in some form or other is invaluable, whenever there is evidence of the effusion of lymph, either adhesions or pellets; but when the disease occurs in cachectic persons, quinine or bark should also be administered. In rheumatic subjects, colchicum and bicarbonate of potash are useful. Turpentine given in half-drachm doses, is said to exercise a most beneficial influence on rheumatic iritis, but it cannot often be given, as it disturbs the digestion and produces nausea and other troubles. Blisters applied behind the ears, or on the temple as far as possible from the eye, may do good.

If the disease assumes a chronic form, or even if it be acute and obstinate resisting all treatment, whenever the tension of the eye is increased, an iridectomy should be done, as this usually cuts short the attack. When the aqueous humour is very turbid, especially if the eyeball is tense, paracentesis (page 43) of the anteriorchamber should be performed, unless an iridectomy be decided upon.

Traumatic iritis is exceedingly liable to give rise to destructive cyclitis.

Iridectomy.—This operation, which was first performed by Von Graefe, has a most decided influence in checking a great number of destructive processes in the eye, accompanied by increase of intraocular tension; as chronic iritis, especially when recurrent, cyclitis, irido-choroiditis, and glaucoma. The *rationale* of its action is not understood, but a hard eye becomes soft, and usually permanently so, after the operation.

The eyelids are to be separated by a stop speculum; the eye is fixed by a pair of conjunctiva forceps, with which the conjunctiva is held about two lines from the cornea on the side opposite to that selected for the operation; the insertion of the rectus tendons affords a very steady fixation. An incision is then made close to the sclerotic margin of the cornea, half a line within the sclerotic, and extending to about one-sixth of the circumference of the cornea, either by making a puncture and counter-puncture with a broad needle and cutting outwards, or with a triangular knife, known as a keratome, which is simply inserted, with its blade parallel with the plane of the iris, as far as its shoulder and withdrawn. A pair of iris forceps are next inserted into the wound, the pupillary margin of the iris is seized and withdrawn. The iris is then cut off close to the cornea, so as to remove the whole segment quite up to its ciliary margin; this is either done by an assistant, or by the surgeon, who has entrusted the fixation of the eye to an assistant after completing the incision, or has dispensed with fixation during the latter stage of the operation (after the incision is completed). Any blood which escapes into the anterior chamber may be removed by gently sweeping a curette over the cornea; no considerable efforts or pressure should, however, be used, as the effused blood will be speedily absorbed. No portion of iris or small clot must be left in the wound, which can be easily cleaned with a curette; both eyes should then be closed and covered with pads of cotton-wool enclosed in fine linen, and a bandage carefully applied. The pads should be changed twice or three times in the next twenty-four hours. The tension of the eye is immediately relieved in general by the operation. The wound usually heals in from two to three days, and when the operation is skilfully performed no after difficulty need be feared.

Serous Iritis.—Sometimes called aquocapsulitis. This is a low form of iritis in which the pupil is usually dilated. Minute flakes of lymph accumulate in the aqueous and give it a turbid appearance; these are very liable to accumulate in a ring opposite the pupil, or to form a cone with its apex upwards on the inner surface of the cornea. It is liable to occur, either as the result of deep-seated mischief in the eye, or of any cause which produces general debility, such as prolonged lactation, constitutional syphilis, &c. The treatment is the same as in low forms of iritis; but iridectomy is not indicated unless there is increased tension of the eyeball. As a rule the prognosis is doubtful.

Irido-Choroiditis is usually the result of recurrent iritis; the iris becomes adherent to the lens capsule, or the pupil becomes occluded with lymph; the iris is then pushed forward by the accumulation of fluid behind it, and the tension of the eye increases. The vitreous becomes cloudy, the choroid undergoes degeneration, and the retina may become detached. The disease is often very insidious. The eye exhibits the same appearance as in iritis, but the patient sees things through a fog or not at all, and often complains of black clouds in the field of vision (scotomata) of rainbows and sparks. In the latter stages of irido-choroiditis secondary cataract supervenes, and patients are often troubled with very brilliant spectra.

Treatment.—Iridectomy performed early in the progress of the disease is the best chance of saving the eye, otherwise the treatment is the same as that of iritis; both eyes are frequently attacked.

Cyclitis, or inflammation in the ciliary region, may, like iritis, be either suppurative or plastic; the former generally arises from injury, the latter from an extension of choroiditis or iritis. Plastic cyclitis may be suspected when there is great tenderness of the eyeball during iritis, together with increased tension, preternatural shallowness of the anterior chamber, and enlargement of the veins of the iris. A large iridectomy performed early is undoubtedly the best treatment. Warm poppy fomentations and the application of atropine freely should be employed, and these are especially useful when an iridectomy is not performed.

The suppurative form of cyclitis is perhaps the most destructive form of inflammation to which the eye is subject. It may follow a wound of the ciliary region, or a blow on the eye; it sometimes unfortunately occurs after an operation for cataract. There is always severe neuralgic pain during the formation of pus, which escapes either through the pupil or from the insertion of the iris into the anterior chamber; enlargement of the veins with some alteration in the colour of the iris are constant symptoms.

Treatment.—The best chance of saving the eye is to perform a large iridectomy; the other treatment of iritis is appropriate. Cyclitis, especially the traumatic form, is exceedingly liable to give rise to general inflammation of the eyeball. In this case, unless the eye be excised early, the other eye is almost sure to be attacked with sympathetic ophthalmia.

Sympathetic Ophthalmia.—An insidious and very destructive form of plastic irido-cyclitis, which is very prone to attack a sound eye as the result of injury to the other eye, and which usually leads to the destruction of the eye unless its course can be checked.

After an injury to one eye, the earliest symptoms of sympathetic ophthalmia in the other eye are lachrymation, fatigue, incontinence of light and pain. The latter symptom may be absent; hence in children the disease often progresses to a dangerous extent, before the parents are aware of it, unless they are cautioned by the surgeon. Sympathetic ophthalmia may commence soon after an injury, especially a cut in the ciliary region or the lodgment of a foreign body in the other eye; on the other hand, even years elapse after the occurrence of such an accident before it is set up; hence the necessity of carefully warning persons of the possibility of its occurrence when from any reason an injured eye is left unexcised.

In sympathetic ophthalmia the iris appears discoloured and swollen, the cornea is hazy on its inner surface with minute granules of lymph, the aqueous is turbid, and the pupil is blocked with similar granules; unless the pupil is kept dilated with atropine, these granules increase and entirely obliterate the pupil, forming adhesions between its edges and between it and the lens. The iris becomes swollen, and is usually pressed forward by the accumulation of fluid between it and the lens. The ciliary region is always implicated, the vitreous becomes turbid, and both the retina and choroid may be destroyed, whilst the vitreous body is prone to undergo degeneration, and the whole eyeball may suppurate.

Treatment.—The injured eye is the cause of sympathetic ophthalmia in the other, and has already become totally blind before sympathetic ophthalmia is set up. The injured eye ought to have been removed before, but on the first symptoms of sympathetic mischief, its removal becomes imperative although unfortunately it may be already too late to save the remaining eye. After the excision of the injured eye, the pupil of the eye affected with sympathetic ophthalmia must be kept dilated with atropine and carefully protected from light. Strict rest to the organ must be enjoined, even long after all symptoms have disappeared, as the disease is very prone to recur. Quinine should be given, as the disease is very lowering; small doses of mercury (Hydrarg. c. creta) may be tried if the disease continue, or blue ointment may be rubbed into the temple but not to the extent of producing even slight salivation. After the removal of the cause, which is imperative, good diet, good air, absolute rest, opium if there is pain, quinine, and the local application of atropine are to be relied on as the best treatment of a disease which, however, except under very favourable conditions, can rarely be conquered if once set up. Iridectomy is apparently worse than useless, at least until the disease has worn itself out, when it may be done, and the lens removed if it has become opaque, with the hope of giving some useful vision and relieving increased tension of the eyeball. The dread of sympathetic ophthalmia should always induce the surgeon to urge the removal of an injured and useless eye, except in cases where suppuration of the eyeball has already occurred, and a stump has been formed; as sympathetic mischief does not appear to occur under these circumstances.

Panophthalmitis.—Suppuration in the vitreous body is usually spoken of as panophthalmitis, because all the tissues become inflamed when this occurs. It is usually due to the lodgment of a foreign body in the vitreous, such as a fragment of iron or a gun cap. With the ophthalmoscope, if the aqueous and cornea be still clear, a yellow reflex can be seen, or the vitreous appears turbid only. There is extreme redness of the eye with chemosis, swollen lids, and muco-purulent discharge from the conjunctiva; the iris is generally pushed forward; the cornea may be clear, but is more often infiltrated with pus; there is usually extreme pain.

Treatment.—It is better to remove the eye than to allow the patient to suffer the prolonged pain of a suppurating eyeball. If the eye is not removed, the process should be hastened with hot fomentations and poultices. The patient must be sustained by a liberal diet, quinine, &c., and the pain alleviated by opium. Sympathetic ophthalmia rarely if ever supervenes on suppurative inflammation. Although it has often been said that it is unsafe to remove a suppurating eye, experience does not show that there is any danger in doing so.

CHAPTER X.

CATARACT.

Cataract—Operations for Cataract—Aphakia.

Cataract.—Opacity either due to changes in the crystalline lens, *lenticular cataract,* or to a deposit of lymph between the capsule of the lens and the lens itself, *capsular cataract.* For practical purposes lenticular cataract may be further divided into two principal varieties, soft cataract, occurring in persons of less than forty years of age, and hard or senile cataract. The hardness depends on age, so that the two forms run into each other; in patients of more than forty years of age there may be a hard nucleus surrounded by soft lens substance.

Soft cataract may be congenital, secondary to deep inflammation in the eye, or the result of a wound of the lens. A congenital form of soft cataract occurs, known as lamellar cataract, in which the central portion of the lens only is opaque. When the iris is dilated with atropine, the periphery of the lens is seen to be quite transparent.

Hard cataract arises from senile changes, the exact nature of which is not understood; it occurs sometimes as an accompaniment of diabetes or albuminuria.

The diagnosis of advanced cataract is obvious; the pupil appears white or dull yellow instead of black. In its earlier stages the eye must be examined with the ophthalmoscope, or by throwing the cone of light from a convex lens (the ophthalmoscope ocular) upon the eye; this is called focal illumination. The pupil should be dilated with atropine first, or commencing cataract will probably be overlooked.

When the ophthalmoscope is used, the mirror only is required; on looking through its aperture, the opacity of the lens will appear as a black central star, *polar cataract*, or as a series of black rays round the circumference of the lens, *circumferential cataract*. With the focal illumination the opacity appears dull white; it is then easy to see whether the central opacity of polar cataract lies in front of or behind the lens. These two varieties are distinguished as anterior and posterior polar cataract. Anterior polar cataract is usual congenital, and appears, when seen with focal illumination, as a small white cone projecting into the aqueous. Posterior polar cataract is, most frequently, secondary to serious inflammatory changes of the choroid and retina.

When the fundus of the eye can be seen, it should be carefully examined to see if it be healthy or not, as it would be worse than useless to perform an operation at a late period of the disease on an eye in which the retina or vitreous has undergone extensive degeneration. Persons with commencing cataract generally have the best vision with a fully dilated pupil, hence they see better in a dull than in a good light; on the contrary, in presbyopia vision is more perfect with a contracted pupil, and presbyopic persons seek a good light and allow it to fall directly upon the eye, rather than upon the objects they are endeavouring to examine.

Treatment.—In cases of soft cataract the lens must be broken up by a needle operation, removed by linear extraction or suction, or in cases in which the edge of the lens is transparent, an artificial pupil should be made, the lens being left untouched. When the cataract is sufficiently imperfect not to interfere very seriously with the education of a child, no operation should be attempted, unless vision is much improved by a dilated pupil, when a small artificial pupil may be made; for in cases of imperfect cataract it should always be remembered that there is the terrible danger of failing, and making an eye, which possesses useful sight, blind at the commencement of life.

In cases of perfect congenital cataract, even although the pupil is active the retina is frequently defective, so that a guarded prognosis should be given.[1]

The safest operation for the removal of the lens is the needle operation. The pupil must be widely dilated with atropine, a needle with a stop is introduced a line in front of the sclerotic margin of the cornea on its inner side. A second needle is then introduced at the opposite point of the cornea. The capsule of the lens is carefully torn through, and the needles are simultaneously withdrawn. The aqueous humour finds its way into the lens, which swells up and undergoes absorption. This process requires several weeks, and the operation will probably need to be repeated more than once at intervals of six or eight weeks.

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[1] Mr. Critchett, 'British Medical Journal,' March 4 and 11, 1876; 'On Congenital Cataract.'

The pupil must be kept widely dilated with atropine during the whole of this period, and both eyes should be carefully protected from light.

The dangers of the operation are, first, the swollen lens may cause undue tension of the eyeball, thus producing a kind of traumatic glaucoma which is rapidly fatal to vision. This arises from the too extensive rupture of the lens capsule and probably from other causes not within the knowledge or control of the surgeon. Should such an accident occur, an iridectomy must be made without delay and the operation of linear extraction should be completed. Secondly, the swollen lens, or portions of the lens which have escaped into the aqueous may press upon the iris, and set up iritis. In such a case the softened lens must be at once removed by linear extraction.

Great care must be taken in breaking up the lens that the posterior portion of the capsule is not injured, or the vitreous will become mixed with the lens substance and prevent its absorption.

The danger of the operation is least in young children, and least when the whole lens substance is softened down. It is greatly increased if the margin of the lens is transparent. Such cases should not be touched except by iridectomy.

The operation of linear extraction is performed in the following manner. A needle operation is usually performed first, and may precede the extraction several days. If the lens is evidently fluid this may be dispensed with. An incision is made with a broad needle about a line from the sclerotic margin of the cornea and two-and-a-half or three lines in breadth. Many operators prefer the keratome for the incision. The capsule is then ruptured with a cystotome; slight pressure on the lower edge of the cornea with a curette may now be sufficient to cause the lens matter to flow out. A more usual mode of procedure is to introduce a narrow curette through the corneal wound into the substance of the lens, which will then flow out through its groove. A third method is to use Bowman's suction syringe.

The advantage of these methods over the simple needle operation is that time is saved and the result of the operation, if successful, is at once apparent and brilliant; while in the needle operation it is slow, the operation often requiring to be repeated. As has been already observed, it may be a necessary sequel to the needle operation, but in most cases the simpler is the safer proceeding. These operations are not suitable in persons over thirty-five years of age, as at a late period of life there is almost certain to be a solid nucleus.

After either operation, a portion of opaque capsule may remain; this must be treated at a later period by another needle operation, by which the opaque portion of capsule may be torn through or displaced. If this cannot be effected, the capsule may be removed with a pair of cannula forceps by a corneal incision made in the same manner as in the operation for linear abstraction. If this is done it will be necessary to introduce a fine pair of forcep scissors to detach the opaque capsule from its margins. Under no circumstances is it safe to pull away the capsule by tearing it from its ciliary attachments. Such treatment is especially liable to light up severe and destructive ciliary inflammation, which will most probably lead to the entire destruction of the eyeball.

If on dilating the pupil with atropine the margin of the lens presents a clear transparent zone, a small iridectomy is far the best and safest treatment; first, because cataract glasses are very inconvenient to young people; and secondly, because such a lens would be sure to swell up and give rise to severe complications whatever operation is attempted; thirdly, because there is no risk in the iridectomy.[1]

The best method of performing this operation is that first introduced by Mr. Critchett. An incision of a line and a half or two lines in extent is made in the border land between the cornea and sclerotic, a small blunt hook is then introduced by which the free edge of the iris is caught and drawn out through the wound, the iris is then snipped off close to the cornea with a pair of fine scissors and the wound freed of the remaining portion of the iris by gently rubbing it over with the finger placed over the eyelid. By this means the pupil is elongated to the edge of the lens by a narrow slit. It is important to remember that whenever an artificial pupil is required for improving vision, the smaller its extent the more perfect will be its action. A large iridectomy is needed to relieve tension, but a small one only is admissible for improving the optical qualities of the eye.

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[1] See an exhaustive paper on 'Congenital Cataract,' by Mr. Critchett, in the 'British Medical Journal,' March, 1876.

It may be laid down as a rule that when both eyes are affected with congenital cataract only one should be operated upon at a time.

In hard Cataract the lens should be removed after the cataract becomes mature; that is, when the whole lens substance has become opaque. If the operation is performed before this happens, the nucleus only of the lens will be removed and a quantity of its soft periphery will remain behind. This is liable to swell up and cause serious inflammation. The operation now usually performed is known as Graefe's linear extraction. It is done in the following manner. Chloroform should always be administered and the operation should not be attempted until the patient is thoroughly under its influence. The eyelids should then be well separated by a stop speculum. The operator standing behind the couch, on which the patient lies, steadies the eye by a pair of conjunctival forceps below the cornea, and inserts a broad needle half a line behind the sclero-corneal junction. At this stage of the incision the point of the knife should be directed towards the centre of the pupil with its blade parallel with the plane of the iris. When the point of the knife lies over the centre of the pupil the direction of its blade must be altered so that it points to the corresponding part of the inner side of the cornea to that at which it entered on the outer side. Pushing the blade gently onward, this point must be perforated; about one third or a little more of the circumference of the cornea should be included between the points of the entrance and exit of the needle. The incision is completed by causing the broad needle to cut its way upwards through the sclero-corneal junction. As the blade emerges it lifts up a flap of conjunctiva and must be turned forwards in emerging from that tissue. The operation in which the incision is confined to the sclero-corneal margin has several advantages: the chief one is that this border land between the cornea and sclerotic is vascular and has more vitality than the cornea itself; another manifest advantage is, the wound is protected and covered by the conjunctival flap; lastly, the wound has a greater length between its two extreme points than any section invading the cornea can have, although the contrary is frequently stated.

A large iridectomy must then be performed. The deformity due to this procedure is the only objection to the operation, but it is far more than compensated for by the great comparative freedom from risk which it affords. The capsule must next be torn through with a cystotome, and too much care cannot be taken at this stage of the operation. The cystotome should be passed to the lower margin of the pupil, or even a little behind the lower segment of the iris, and the capsule gently scratched through without making undue pressure on the lens which might drive it into the vitreous. First along each margin of the pupil so that a V-shaped incision with its apex at the lower margin of the pupil is made through the capsule. The two upper extremities of the incision are then to be joined by a third scratch.

During the whole of the operation, great care must be taken that in fixing the eye no pressure is made upon it with the fixing forceps, as this would either cause the escape of vitreous before the lens, or dislocation of the lens itself.

After withdrawing the cystotome, gentle pressure is to be made with a broad curette, just below the lower margin of the cornea in such a direction (upwards and backwards) that the upper margin of the lens may tilt towards the upper part of the incision; the lens is then coaxed out by a sweeping movement of the curette over the cornea.

Unless the incision is made too far in the sclerotic or the vitreous is very fluid, vitreous is seldom lost in this operation. The iridectomy adds greatly to the safety of the proceeding and is no real disfigurement or loss to the patient. The surgeon must be able to use the knife with his left hand when the left eye is operated on, as the cornea can only be entered from its outer side.

Flap Extraction, or upper section, as it is sometimes called, has been practically almost superseded by Graefe's operation. The corneal wound is much larger, occupying nearly $\frac{2}{5}$ instead of $\frac{1}{3}$ of its circumference, and the iris is liable to suffer bruising; it has the advantage, however, of being easier to perform without chloroform, giving less pain and taking much less time. If it be desired on account of a valid objection to chloroform, the section may be made either above or below the horizontal meridian of the cornea. A broad, triangular knife (Sichel's knife) should be used. The point is introduced at the outer sclero-corneal junction at its horizontal meridian and brought out at the opposite point. The back of the knife must be kept close up to the cornea, as the knife is passing in, or aqueous will escape and the iris will fall forward upon the knife. The fixing forceps should be used in this operation to hold the eye steady until the counter-puncture is made, but may be dispensed with when the corneal section is nearly completed, which is done by pushing the blade onward. The incision is to be completed by drawing the knife back, and should have its upper part from one to two lines within the cornea itself. No iridectomy is done in this operation, although it sometimes happens that the iris falls over the knife and is accidentally wounded, an accident which cannot always be avoided. The capsule is lacerated, and the lens removed as in Graefe's operation. By standing in front of the patient and doing a lower section of the cornea, the left eye may be operated on with the right hand.

If the lens cannot be removed easily, it becomes necessary to introduce a scoop behind it, by which it is lifted out. If any blood or soft lens matter remain in the anterior chamber, an endeavour should be made to remove it, by carefully sweeping a curette over the cornea; but some had better be left than that any undue efforts should be made in its removal. Before covering the eye after an operation for cataract, two or three drops of atropine solution should be introduced, and the surgeon should see that the iris is not entangled in the corneal wound, and that the corneal wound does not gape; its edges should be cleared of iris or blood with the curette, or by moving the upper eyelid over it with the finger; they may also be adjusted in the same manner. The eyelids of both eyes should then be closed and covered with suitable pads of cotton wool enclosed in a single fold of thin linen, and a bandage carefully adjusted over them. The pads should be replaced twice a day, but unless the presence of pus reveals the fact that things are progressing unfavourably, the eye should not be opened for three days, when adhesion should have taken place between the lips of the corneal wound. It is useless to dilate the pupil with atropine before cataract operations, as it always contracts again as soon as the aqueous humour escapes, and there is more danger of wounding the iris or of getting a prolapse, as its thickness is considerably increased during dilatation of the pupil. If both eyes are operated on at the same time, Mr. Critchett prefers making the incision strictly corneal in one, and in the sclero-corneal boundary in the other, since this gives the patient a double chance. The danger of the sclero-corneal wound being iritis and cyclitis, that of the corneal wound being suppuration of the cornea, he argues fairly that a patient would not be liable to both complications, so that the risk of failure is divided by this proceeding.

Aphakia.—Absence of the crystalline lens, either from the operation for cataract or from accidental displacement or absorption of the lens. In this condition it is of course necessary to add to the refractive power of the eye by a convex glass of corresponding refractive power. The glass requisite varies from $\frac{1}{4}$ to $\frac{1}{3}$ for distant objects, and from about $\frac{1}{3}$ to $\frac{1}{2}$ for near ones. After the operation for cataract, some astigmatism often arises from an alteration in the curvature of the cornea. This can sometimes be corrected by a cylindrical glass, but it is occasionally too irregular, resulting from flattening of one segment of the cornea. In this case vision can often be greatly improved by a horizontal stenopaic slit on the ocular face of the spectacles. It is unwise to allow the use of spectacles for two or three months after the operation for cataract. They may be ordered to be used occasionally two months after the operation. The patient seems to learn gradually the use of the glasses; $\frac{20}{40}$ is generally considered a good result for distant vision, $\frac{20}{20}$ may be attained by glasses which correct the refraction with perfect accuracy; in general, however, such brilliant results are hardly to be hoped for. Jager 4,[1] read at twelve inches, is very satisfactory in most cases.

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[1] See Appendix.

CHAPTER XI.

AFFECTIONS OF THE RETINA AND OPTIC NERVE.

The Ophthalmoscopic Appearance of the Healthy Retina—The Field of Vision—Scotomata—Phosphenes—Hyperæmia of the Retina—Serous Retinitis—Neuro-Retinitis—Retinitis Syphilitica—Idiopathic Retinitis—Choked Disc—Hæmorrhage into the Retina—White Atrophy—Detachment of the Retina—Retinitis Pigmentosa.

The Appearance of the healthy Retina with the Ophthalmoscope.—The optic disc is first seen; it may be either round or oval. The oval disc does not in itself show astigmatism, it is only when its form alters when the ocular is withdrawn that this is indicated. The inner side of the disc (apparent outer side in the inverted image), is not so white as the outer portion. The centre of the disc may be depressed somewhat; this is the physiological cup and differs from the cupped disc of glaucoma in not having over-hanging edges, a fact which is learned by the absence of any break in the vessels as they pass over the edges of the disc. One edge of the disc is often surrounded by a narrow black crescent of pigment; this is congenital and is not abnormal, or at least is no indication of disease. Sometimes one or more spreading brushes of white nerve-fibres extend beyond the disc, often half across the fundus; this is likewise a congenital condition which does not interfere with vision. The retina itself varies much in colour, being most difficult to see in dark individuals, especially if myopia exist. The periphery of the fundus and the yellow spot should always be examined, the beautiful stippled details of the normal retina and the yellow spot should be examined in the erect image, their appearance can only be learnt by careful observation. The student should not be satisfied until he sees the details and the finest vessels, as he would see the details of any external structure with a good light and a magnifying glass; any less perfect image indicates that he has not yet learnt the art of using the ophthalmoscope. Beginners appear usually satisfied with a hazy indistinct picture, and some never see more because they imagine that nothing more can be seen. It is a mistake to use too bright a light, as the pupil contracts under its stimulus; a moderate or even a dull light often illuminates the retina better than a brighter one, because the pupil is wider under its influence. The yellow spot is the most difficult part of the retina to see, because the pupil contracts most when the light falls upon it. The examination of the retina by the erect image requires more practice, but is far more satisfactory, as very minute details are then visible.

Amblyopia, or indistinct vision, is a term which should only be used to signify that indistinctness which is due to changes in the retina. A patient is said to be amblyopic when, after the correction of the errors of refraction, more or less indistinctness remains.

Amaurosis signifies loss of sight from changes in structures beyond the retina, as the optic nerves or central organs of vision.

The Field of Vision.—The examination of the extent of the field of vision is a most important aid to the diagnosis of some affections, and various instruments have been devised for this purpose. Roughly the extent of the visual field may be measured as follows. The patient is placed so that his eye is about four feet from that of the surgeon; one of the patient's eyes is to be covered with his hand or a small screen, the surgeon closes or covers his own eye opposite to the patient's closed eye. Suppose the field of vision of the patient's right eye is to be examined, the surgeon closes his own right eye and the patient's left, and then the patient is told to look directly at the surgeon's eye; the surgeon, looking at the patient's eye, moves his hand midway between his eye and that of the patient at the periphery of the field of vision. If the hand is lost sight of by the patient whilst it is seen by the surgeon, the patient's field of vision is imperfect. The above method has this advantage—the surgeon sees that the patient's eye remains steady, and does not follow his hand.

Another method is to place the patient with one eye closed, in front of a black board with a spot upon it, and to direct him to keep his eye steadily fixed on the spot, the surgeon can then mark out the limits of the field of vision with a piece of chalk; the white chalk against the black board is a good object for testing the limits of the field.

Scotomata are black clouds in the field of vision usually due to opacities in the vitreous, or degeneration or detachment of portions of the retina.

Vision may, however, be defective in portions of the field without the appearance of any black cloud. The blind spot of the healthy retina is a well-known example of this phenomenon. The mind fills up the discontinuity of the picture in the most consistent manner, so that no impression of imperfect vision is produced.

Phosphenes are rings of bright light, produced by pressure upon the eye. In some conditions of health, as in sick headache, phosphenes are sometimes very readily produced, even by closing the eyes. They are not necessarily indicative of anything but abnormal sensibility of the retina, unless accompanied by other symptoms.

Affections of the Retina.—Some difficulty will be experienced by the student, at first, in studying the diseases of the retina, owing to the very confused state of the nomenclature used by various authors. The terms Retinitis and Neuro-retinitis are used with very different significations. Many of the affections classed as retinitis are not the results of hyperæmia, and do not appear to have any connection with it. It would be foreign to the purpose of this work to attempt any discussion of the difficulties which arise in the etiology of diseases of the retina, therefore a concise description of the ophthalmoscopic appearances presented under the names most commonly made use of in practice is all that will be attempted, with the treatment most appropriate for each form.

Hyperæmia of the Retina.—The most common cause of hyperæmia of the retina is astigmatism and hypermetropia. The optic disc appears redder than is normal, its edges are hazy, and the retina around it has a woolly appearance. There is, however, no distinct swelling of the disc.[1] Mere redness of the retina must not be relied on, for its apparent vascularity varies very much in different individuals, fair persons having apparently a much more vascular retina than dark ones. In this affection there is always very considerable asthenopia, and even after the errors of refraction have been corrected, much amblyopia must be expected.

Treatment.—Rest from work, the use of Guttæ atropiæ for some days, or even weeks, during which the eyes must be kept carefully shaded, and the judicious local abstraction of blood by the artificial leech, do much to relieve the amblyopia. As soon as possible, appropriate glasses should be prescribed

[1] Plate I., fig. 2.

and worn constantly; unless the amblyopia is considerable, these alone, with rest whenever the eyes are fatigued, may be relied on to produce a healthy condition of the retina in a few weeks.

Serous Retinitis.—An acute disease of the retina, producing blindness in a few days or hours, has been described under this term. The disc is red, swollen, and ill-defined, with a woolly look. The whole of the fundus exhibits the appearance of being covered by a grey or greenish transparent veil, which obscures the vessels of the retina. The arteries are not enlarged, but the disc is swollen and the veins are too large, often being elongated, tortuous, and distended; appearances which rather favour the idea that the change is due to the effusion of serous fluid (dropsy) than to a true inflammatory process. There are no symptoms of irritability, photophobia, or lachrymation. The result may be atrophy and permanent blindness, although if the fluid is speedily absorbed, the best results may be hoped for.

The iris is sluggish to respond to the stimulus of light, and the patient complains of a gradually or rapidly increasing fog before the eyes; the field of vision contracts from its periphery.

Treatment.—Local depletion by the artificial leech applied to the temple, diuretics and diaphoretics, and rapid mercurialisation by inunction of blue ointment are the best remedies. The eyes should be carefully guarded from light for some time after the attack as well as during its continuance. I am inclined strongly to the belief that mercury is the only reliable remedy in such cases; as no harm can arise from its judicious administration, especially when the patient is brought rapidly under its influence, this remedy must never be neglected. All practical men understand the difference between bringing a patient, suffering from an acute and destructive disease, rapidly under the influence of this most important drug, and keeping chronic cases under its influence for weeks or months. The cachexia induced by the latter procedure is undoubtedly a serious and lasting ill, and cases of this kind, where the drug has been abused, are made use of by certain theorists to decry its use when its assistance is most invaluable, and the harm possible from its administration absolutely imperceptible, if it exists at all.

Retinitis or Neuro-retinitis.— These terms are usually applied to those conditions of the retina in which white patches appear in its substance. These are usually spoken of as exudations, although they really consist of new cells formed in the connective tissue framework of the retina. It occurs in secondary syphilis, in cases of albuminuria, and as the result of hæmorrhages into the retina, choked disc, and perhaps of serous retinitis. It is usually chronic, and is not attended at first with amblyopia, although portions of the field of vision are lost, so that blind spots occur.

Nephritic Retinitis (Retinitis Albuminuria).—Both eyes are usually attacked. The disc is red and swollen, the veins being especially enlarged. Numerous white glistening patches form around and at some distance from the disc. These ultimately form a broad ring round the disc, and are closely packed together, especially on its inner side; between the ring and the disc the retina is free from them, but beyond it numerous often stellate white patches are scattered over the retina. This condition is preceded by frequent hæmorrhages into the substance of the retina; it is characteristic of renal disease.[1] There is contraction of the field of vision, and after a time considerable amblyopia.

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[1] Plate III., fig. 5.

Treatment.—The renal affection must be treated; the retinitis usually disappears after the cessation of the albuminuria, and the white 'exudations' are often entirely absorbed. There is frequently no permanent impairment of vision.

Retinitis Syphilitica.—The disc is usually neither so red or swollen as in nephritic retinitis, the hæmorrhages are not so extensive, and the 'exudations' are less regular in their distribution, and greyer or yellower in colour. The disease is very insidious and chronic; the choroid often undergoes extensive degeneration, and in the latter stages of the disease large glistening white patches occur surrounded usually by a dense fringe of black often stellate collections of pigment.[1] The corresponding portions of the field remain permanently and hopelessly blind.

Sometimes the first appearances of syphilitic retinitis resemble those of serous retinitis, but they are seldom so sudden in their occurrence.

Treatment.—In its earlier stages much may be hoped from the usual anti-syphilitic treatment.

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[1] Plate IV., fig. 7.

Syphilitic retinis is often overlooked, owing to no very marked subjective symptoms occurring at first to the patient. It occurs with the earlier secondaries, and relapses may continue to recur for years. The most efficacious remedies are the bichloride and biniodide of mercury. The bichloride may be administered in combination with iodide of potassium. In old standing cases we must rely on the iodide of potassium alone, and except the prevention of further mischief, but little must be expected.

Idiopathic Retinitis is seldom seen in this country, but exposure to bright light in the tropics, and on snow-covered tracts, produces inflammation of the retina with grey or white exudations.

Treatment.—Rest and the local abstraction of blood by the Heurteloupe, with dark glasses constantly worn in the day, are the most important topical means. Mercury should be tried, without doubt, in such cases.

Choked Disc (Ischæmia of the disc, Neuroretinitis of some authors). The disc is much swollen, projecting into the eye so that its surface is distinctly seen in the erect image with a convex glass, perhaps even of $\frac{1}{10}$ or more in the emetropic eye, and a corresponding addition in ametropic eyes. It is woolly in appearance, the veins enormously distended, and the arteries often thready. There are streaks of effused (hæmorrhagic) blood in the disc, and its edges are red, confused, and blurred. This condition produces hæmorrhages and white 'exudations' in the surrounding retina, under which the vessels are often lost to view. The patient can only count fingers, or perhaps cannot even perceive light in extreme cases; both eyes are commonly attacked. The condition is usually due to tumours in the orbit, or clots, or other lesions in the brain. Not only is the vision of the patient threatened, but when severe cerebral symptoms exist his life also is in imminent danger. White atrophy is a most frequent result if the patient survive.

Treatment.—General principles are our only guide in the treatment of this malady, and it comes rather within the notice of the physician than that of the ophthalmic surgeon, by whom such cases are seldom seen until blindness has already been produced.

Hæmorrhage into the Retina may occur either as the result of one of the affections already described, or like other vicarious hæmorrhages, may arise with suppressed menstruation, especially at about the period of life when the catamenia cease. In these cases we must have recourse to general treatment, the uterine disturbance must be relieved if possible. Locally our attention must be directed to the promotion of absorption; perhaps the Heurtiloupe applied to the temple is the most efficient agent. Its application should be repeated at those periods when fresh hæmorrhage is to be dreaded.

Embolism of the arteria centralis.—The patient becomes suddenly blind, perhaps waking in the morning without even the perception of light in one eye. With the ophthalmoscope, the arteries are seen to be reduced to mere threads, empty in places, so that it may not even be possible to trace them. The veins usually have small collections of blood in parts of their course, but are otherwise empty. The disc is not swollen, red, and prominent, as in choked disc, but is too white and often considerably cupped, so that its centre is seen by a less convex glass, or by a stronger concave one than the edge, when observed by direct observation.[1] In a short time the retina becomes swollen in the region of the yellow spot, which may even appear to lie in the centre of a whitish disc. Sometimes in the earlier stages of this condition, a pulsation is observed in the arteries and veins of the disc. There is no treatment, and after a short time atrophy of the disc and retina supervenes.

White Atrophy.—In this disease the patient has a peculiar vacant stare, quite characteristic of the disease; the iris is dilated, and does not act with the stimulus of light, there may not even be the power of the perception of light. The optic disc appears of a glistening white colour. No vessels, or only small ones are seen crossing it, and the vessels around it are reduced to small thread-like tracts. The disc itself shows frequently minute dots over its surface, the perforations of the sclerotic, through which the nerve-fibres enter.[2] White atrophy may be the result of retinitis or choked disc. It occurs sometimes without any apparent inflammation or previous change, affecting both eyes simultaneously; vision becomes more and more imperfect, and the disc and optic nerves gradually undergo atrophy; in a few months only large objects are capable of being distinguished. This form of atrophy is usually believed to result from the excessive use of tobacco, and is apparently checked by a discontinuance of its use. It is certainly common in inveterate smokers, but it appears to occur as the result of any lowering cause, dissipation, drink, &c., in some constitutions. It is possibly the result of some central nerve-change.

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[1] Plate IV., fig. 8.

[2] Plate II., fig. 4.

Treatment.—Attention to the general health and, if possible, the removal of the cause are the main elements of treatment. Tr. nucis vomicæ has certainly a beneficial influence in checking white atrophy for a time in some cases. As a rule, when atrophy has commenced, it is too late to expect much from treatment. The most recent observations show, however, that when atrophy is due to tobacco, very great improvement may be expected from the discontinuance of smoking.[1]

Detachment of the Retina.—A small portion, or a considerable extent of the retina, may be separated from the subjacent choroid, either as the result of injury, retinitis, or more commonly from progressive myopia, with considerable posterior staphyloma.

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[1] J. Hutchinson, 'Ophth. Hosp. Reports,' 1876.

With the mirror of the ophthalmoscope alone a portion of the fundus gives a grey reflex if the detachment is considerable. The detached fold of retina is seen distinctly in the erect image floating forward in the vitreous. It has a peculiar tremulous motion, large vessels are often visible, but its surface is ashy grey; small detachments of the retina are not so easily seen. There is, of course, absolute loss of vision in that portion of the field which corresponds to the detached portion of the retina, if this is large; but small portions of detached retina certainly retain some power of distinguishing objects imperfectly, for a short time at least. The symptoms complained of are a cloud of uncertain and varying outline in the field of vision, whilst objects in its vicinity often appear distorted or fringed with halos.

Treatment.—It has been proposed to perforate the sclerotic, choroid, and retina in the detached portion, with a needle, for the purpose of letting fluid effused under the retina escape into the vitreous body. The operation has, however, fallen into disuse. All we can do is to protect the patient, if possible, from a recurrence of the cause, and by the use of atropine and careful shading from all light for a time, prevent any efforts of accommodation.

Retinitis Pigmentosa.—It is doubtful whether this affection should be considered as a form of retinitis. It is characterised by the formation of numerous often stellate deposits of pigment in the retina commencing at the periphery and gradually extending to the fundus.[1] The deposits often follow the course of the vessels. The disease is usually hereditary, and commences very early in life. The field of vision becomes more and more contracted as the disease advances; thus it sometimes happens that perfect vision remains in the region of the yellow spot although the periphery of the field is entirely lost. As a rule, both eyes are affected, and the yellow spot becomes implicated at about thirty-five or forty years of age, when the eyesight is entirely lost. In the earlier stages of the disease night blindness is a very characteristic symptom. The strongly pigmented periphery of the retina is so characteristic that retinitis pigmentosa can hardly be mistaken when it has once been seen. It is distinguished at once from the pigmented condition observed in advanced syphilitic retinitis by the absence of white patches and by its commencing at the periphery of the retina and gradually extending towards the disc.

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[1] Plate II., fig. 3.

No treatment is known which has the slightest effect on retinitis pigmentosa.

CHAPTER XII.

GLAUCOMA.

Definition—Varieties of Glaucoma—Premonitory Glaucoma—Confirmed Glaucoma — Glaucoma Simplex: Treatment — Acute Inflammatory Glaucoma — Treatment — Chronic Inflammatory Glaucoma — The Glaucomatous Cup — Secondary Glaucoma—Iridectomy in Glaucoma —Treatment of Premonitory Glaucoma.

Glaucoma is so named from the green colour of the pupil, which results from turbidity of the vitreous in the latter stages of the disease. It is one of the most destructive affections of the eye, and yet one in which the surgeon can do most to avert total and irremediable blindness, if the disease is correctly and early diagnosed.

Glaucoma consists in increased tension of the eyeball, which leads to degenerative changes in the retina, choroid, and indeed of the whole internal mechanism of the eye. It is a disease of advanced life, rarely occurring before forty, although cases are recorded in which it has occurred in youth. The majority of patients suffering from this disease are between forty-five and seventy years of age, and more than half are between fifty and sixty years.

If the diagnosis of increased tension of the eyeball were an easy matter, that of glaucoma would be comparatively simple; but the tension of the normal eye varies in different individuals, and it is only by long experience that the minor degrees of increased tension can be detected and the surgeon may be in doubt as to an increase of tension that would nevertheless sooner or later set up destructive changes in the retina. Absolute and undoubted increased tension indicates unmistakeably already existing or threatened glaucoma, but, on the other hand, the young surgeon must be cautious in concluding that an eye is safe because he fails to satisfy his mind of a decided increase of tension.

Fortunately in the majority of cases the concomitant symptoms are sufficiently marked to preclude the probability of mistake, but this is by no means always the case. Glaucoma presents, as a rule, two stages; the so-called premonitory and confirmed conditions.

In the Premonitory Stage of Glaucoma which may precede confirmed glaucoma by a very variable period, there is usually rapidly increasing presbyopia requiring a repeated change of glasses for near work. Halos or coloured rings appear from time to time around the candle or artificial lights and the field of vision is more or less obscured at times as if the patient were looking through a fog, or he complains of the appearance of smoke before his eyes. The tension of the eyeball is more or less increased, the retina is usually congested and the arteries either exhibit a spontaneous pulsation when seen with the ophthalmoscope, or pulsation is produced in them when the eye is lightly pressed upon by the finger.

The symptoms of the premonitory stage, except the presbyopia, which is permanent, occur from time to time, lasting only for a few hours at most, with intervals of complete remission, in which vision is restored to its normal condition. A period ranging from a month to a year, and sometimes, but more rarely, of several years, intervenes before they are succeeded by a confirmed attack.

Treatment.—It is generally admitted that iridectomy should not be performed in the premonitory stage of glaucoma or at least only under very exceptional circumstances, as when the patient is likely to be lost sight of, or when decided hardness remains after the attack has passed off. In this stage, however, every precaution should be taken against cerebral congestion, and external causes giving rise to ocular congestion, such as bright, especially scintillating, lights, cold wind and dust. Grey protective glasses should be enjoined, and the patient should be prohibited all excesses both of eating and drinking. Sleep immediately after the principal meal should be forbidden; strong tea and coffee are contraindicated. Any causes of ill-health must be carefully investigated, and if possible removed. The patient should be always kept sedulously under observation, so that iridectomy may be performed at once if the confirmed stage sets in; that is, as soon as the impairment of vision ceases to be transitory, or inflammatory symptoms occur.

Confirmed Glaucoma exhibits one of three very marked types known as glaucoma simplex or non-inflammatory glaucoma, acute inflammatory glaucoma and chronic inflammatory glaucoma.

Glaucoma Simplex is characterised like the whole group of glaucomatous affections, by increased intra-ocular pressure, excavation of the optic disc, and destruction of the power of vision. The eye exhibits no undue vascularity, the cornea is quite clear and bright, there is no pain or narrowing of the anterior chamber, and it is not always easy to detect increased hardness of the eyeball. The premonitory stage of the disease is usually wanting, and if no inflammatory attack occurs in its progress, the patient may not be aware of any impairment of vision; he still reads the smallest type without difficulty, when his rapidly increasing presbyopia is corrected with glasses; but the edges of the field of vision are continually contracting, and the optic disc is deeply cupped by the increased intra-ocular pressure. More frequently, however, the patient finds his sight dim at times, clouds of mist or smoke-like patches seem to float before his eyes, the pupil is widely dilated and sluggish in its movements, and the patient is aware of rapid deterioration of vision, especially if both eyes are affected. The disease is essentially of the most insidious type, and is not commonly attended by any pain, although intermitting neuralgic pains are sometimes present.

Treatment.—Glaucoma simplex is the least hopeful form of glaucoma, because iridectomy often fails to arrest the increase of tension. There is, however, no other known and tried remedy. A second iridectomy at the opposite side of the iris has been recommended, when the first fails to reduce the intra-ocular tension. Sclerotomy [1] has also been tried, but the number of cases in which this has been done are at present too few to allow of its comparison with iridectomy.

Acute Inflammatory Glaucoma.—After a longer or shorter premonitory stage, the eye is suddenly attacked with intense inflammation. The vessels of the subconjunctival tissue become distended and tortuous, so that a deep red zone surrounds the cornea. Severe congestion of the whole conjunctiva is also frequent, and there is often severe chemosis as well as redness and swelling of the eyelids. The cornea loses its sensibility and becomes cloudy; neuralgic pain of the eyeball and brow, often of a very intense character, occurs, especially at night; the pupil is widely dilated and the iris is sluggish in its movements, or does not act under the stimulus of light. The colour of the iris is usually altered by turbidity of the aqueous humour, whilst the anterior chamber is very shallow because the iris and lens are pushed forward. The eyeball during such an attack is stony in its hardness, its tension being increased to the highest degree, so that it will not even dimple under the finger; the patient complains of a rapidly increasing deterioration of vision, so that sometimes even in a few hours (*Glaucoma fulminans*) no power of distinguishing more than the difference between light and darkness remains. The duration of the acute inflammatory attack is very various; in some cases it expends itself in a few hours, in others it may last several days. After this the pain ceases, the injection of the conjunctiva and sclerotic disappears, and vision gradually returns or improves up to a certain point, until after a few days or weeks, a second inflammatory attack of the same nature supervenes. After each successive attack the recovery is less perfect and the visual field is more contracted, until the disease either passes into the chronic form or vision is entirely lost.

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[1] This operation consists in a subconjunctival division of the sclerotic, immediately in front of the iris, to the extent of one-fourth of its circumference.

After the first or second attack the patient often flatters himself that he is recovering from a transient disorder, and this idea is often shared by his medical attendant, as it is fostered by the fact that sickness with disturbance of the digestive organs, and general malaise often accompanies the inflammatory exacerbations. Increased tension of the eyeball being overlooked, although it remains after the more apparent symptoms have passed off.

In the earlier stages of acute glaucoma the ophthalmoscope shows that the retina is highly congested, and its veins are large and tortuous. The arteries and sometimes even the veins exhibit pulsation; but it is by no means essential that the optic disc should be cupped at this early stage. It is most probable that no characteristic cupping will be observable. In many cases the vitreous is too hazy, during the acute inflammatory stage, for the fundus to be distinctly seen.

Treatment.—Iridectomy usually at once arrests the progress of acute glaucoma, and improvement of vision commonly follows the operation, unless it is too long delayed. The pain is relieved almost immediately by recourse to this measure; we should not therefore wait for an intermission in the acute stage of the disease, but operate at once. All other remedies are useless.

Chronic Glaucoma is distinguished from the acute form, by its slower and more insidious progress. As has been already stated, it may follow upon one or more acute attacks. The pain is far less violent, the injection of the conjunctiva less marked or absent, the injected vessels being subconjunctival. The changes are the same, however, as those characteristic of the acute form except in the slowness of their development. Iridectomy is far less likely to produce beneficial results, probably because it is always done at a later period in the disease; for the chronic form is either the sequela of the acute form, or patients do not apply for relief, or consent to iridectomy, until the disc is deeply cupped. It is, however, the patient's only chance of retaining useful vision.

The Glaucomatous Cup.—Whenever increased tension of the eyeball has existed for any considerable length of time the ophthalmoscope reveals the characteristic cupped appearance of the optic disc. The whole disc is deeply depressed from its extreme margin and its edges are excavated, so that the vessels of the retina, as they pass over the margin of the cup, appear interrupted or broken, the peripheral portion being displaced.[1] The beginner will find it difficult to convince himself that he is not looking at a projecting hemispherical surface, but examination by the direct image will at once convince him that the appearance is delusive.

Great care must be taken not to mistake an atrophic, or a physiological cupping of the optic disc, for a glaucomatous cup. The atrophic cup has no overhanging edges, so that its thin thready vessels do not appear displaced as they pass over its margin.[2] The physiological cup is merely a variation in the normal conditions, the cupping does not extend to the margin of the disc, and the vessels never appear broken as its edges never overhang its cavity like those of the glaucomatous cup.[3]

Secondary Glaucoma.—This term is applied to glaucoma arising from some other lesion of the eyeball. The most common causes of secondary glaucoma are staphyloma of the cornea and iris, adhesions of the iris, traumatic cataract, dislocation of the lens, cyclitis, irido-choroiditis, hæmorrhagic retinitis, hæmorrhage into the vitreous body, and intra-ocular tumours.

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[1] Plate III. fig. 6.

[2] Plate IV. fig. 8.

[3] Plate I. fig. 1.

The causes of the secondary forms of glaucoma throw no light upon the etiology of the disease, as they are in themselves the cause of the increased tension. Glaucoma of this kind is not the disease, but the result of other diseases. Primary glaucoma signifies hardening of the eyeball from an unknown cause.

Iridectomy in Glaucoma.—The rationale of the operation, like the cause of glaucoma, is unknown. Von Graefe must ever be held in the highest honour for the discovery of iridectomy, and the careful manner in which he proved its efficacy, against all opposition, in relieving tension of the eyeball; nor must we turn from the only means we possess of relieving this distressing disease, and preventing blindness because we are unable to understand its action; it is too certain a remedy for its efficacy to be doubted by any who know anything of its effects in glaucoma. It is true that iridectomy has been too frequently abused by men who use it as a means of introducing an operation where an operation is unnecessary and useless, as for instance in white atrophy; but the case is different in glaucoma. No doubt can be entertained of its curative properties, and the delay sometimes only of a few hours to perform the operation, when increased tension exists, may produce irreparable mischief.

In order that iridectomy may produce diminished tension of the eyeball, a large segment, at least a quarter or even a third of the iris, must be removed, and it must be taken away quite up to its ciliary border. To ensure this the incision must be made half a line behind the cornea, through the sclerotic, that is, immediately in front of the plane of the iris.

The following considerations must always be present in the mind of the surgeon when called upon to decide upon or against the performance of iridectomy in glaucoma.

1st. No iridectomy should be performed in the premonitory stage of glaucoma so long as vision remains normal, and the field of vision is not contracted, for he should remember that although the operation is usually harmless, a disastrous result may occur and he may have the blame of destroy-ing an organ of inestimable value. The patient must, however, be carefully watched, as cupping of disc, deterioration of vision, and contraction of the visual field should at once indicate the necessity of an iridectomy, as the best and only chance of saving the patient from irremediable blindness.

2nd. The appearance of acute inflammatory symptoms in a hard eye should at once cause him to decide on an operation without delay, because it is in acute inflammatory glaucoma that the most brilliant results accrue from the operation. The question sometimes arises as to whether a patient should perform a journey whilst suffering with acute inflammatory glaucoma for the purpose of undergoing an operation; delay in such a case would be far more dangerous than a journey.

3rd. In chronic inflammatory glaucoma an early operation is the patient's best chance; he will probably by this means retain whatever vision remains at the period of the operation. In glaucoma simplex the operation is still demanded, but is less often successful than in the acute and chronic forms.

4th. There is a form of glaucoma simplex, in which the eyeball becomes of stony hardness in a few hours, with absolute loss of vision, but without inflammation (*Glaucoma maligna,* Von Graefe), in which iridectomy is followed constantly by intra-ocular hæmorrhage. In such cases the best authorities would agree that iridectomy had better not be performed; they are, however, nearly hopeless from the first.

5th. Although iridectomy is the best chance in secondary glaucoma, except where there is an intra-ocular tumour or hæmorrhage into the vitreous, but little must be expected from the operation. When the pressure is due to a swollen lens it must, of course, be removed.

6th. In glaucoma complicated with senile cataract, the lens should never be removed at the same time the iridectomy is done, or intra-ocular hæmorrhage is almost sure to occur.

CHAPTER XIII.

INJURIES, TUMOURS, AND MALFORMATIONS.

Abrasions and Cuts of the Cornea and Ciliary Region—Foreign Bodies—The Effects of Blows—Effusion of Blood—Rupture of the Sclerotic—Dislocation of the Lens—Malignant Tumours—Glioma—Osseous Tumours—Exophthalmos—Cysticerci—Colour Blindness—Coloboma of Iris and Choroid—Persistent Pupillary Membrane.

Injuries to the Eye.—Even those which are apparently the most trivial may lead to the gravest results; hence every precaution should be taken in all cases.

Abrasions of the cornea give rise to irritation and pain quite out of proportion to the gravity of the injury; absolute rest in a dark room, Guttæ atropiæ, and leeches, if necessary, to the temple, are the best treatment. Many surgeons recommend a drop of Oleum Ricini to be put into the eye frequently, as the film formed by it is supposed to supply the place of the injured epithelium. Cases usually do well.

Cuts in the cornea and in the ciliary region are far graver, especially the latter; prolapse of the iris is exceedingly liable to occur. Atropine in these cases often fails to produce dilatation of the pupil, owing to loss of the aqueous. If seen early and the iris is prolapsed, the prolapsed portion should be removed or an iridectomy may be performed. If the iris cannot be freed from the wound, it must be left. The eye should then be kept bound up with a pad moistened with Fotus belladonnæ, which must be frequently renewed. A prolapse may be afterwards treated by puncture, for the folded iris will become a cyst full of fluid protruding from the surface of the cornea. It may be necessary to puncture this cyst many times before it shrivels. If the sight be lost, it is better to remove the eye than to risk sympathetic ophthalmia, for if cyclitis exists it is nearly sure to occur.

Foreign bodies impacted in the cornea must be removed; sometimes when splinters of steel, &c., have almost penetrated, it is better to pass a broad needle under them rather than to risk pushing them through the cornea by attempting to remove them in the usual way with a spud.

Small foreign bodies often pass into the lens or vitreous; an opaque tract can then be seen indicating their course. If in the lens, the lens must be removed; if in the vitreous, an attempt should be made to remove the foreign body after removing the lens; if this fail, the eye will sooner or later require to be excised, and it is best to do the operation at once. Of course the surgeon, before he takes the step, must be sure the foreign body has passed into the eye, unless total blindness has already been produced, when he will do well by assuming that the foreign body is in the eye.

Foreign bodies of large size have been found lodged under the conjunctiva in the orbit even months after they have become impacted.[1] A search should always be made when there is reason to suspect such an accident.

Blows on the Eye may produce effusion of blood under the conjunctiva or into the anterior chamber, without graver mischief. In either case the blood will be speedily absorbed; twenty-four hours usually suffices for the absorption of blood from the anterior chamber, but days or even weeks may elapse before the subconjunctival ecchymosis is entirely absorbed. Effusions of blood into the vitreous are far more grave; they often remain for years and give rise to panophthalmitis. Effusions under the retina and detachment of the retina may occur from blows. In effusion into the anterior chamber, little or no treatment is needed; in effusions behind the lens no effective treatment is known.

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[1] See Mr. G. Lawson's exhaustive work on 'Injuries of the Eye.'

Rupture of the sclerotic near the cornea is not uncommon as the result of a violent blow, with or without prolapse of the iris. In the later case the eye is usually lost, as there is probably a large effusion of blood into the vitreous or between the retina and choroid, and the eye should be excised. An attempt must be made to save the eye when no large effusion has taken place into the tissues behind the lens. The eye should be bound up, leeches applied to the temple, and the patient kept in darkness. Dislocation of the lens also occurs as the result of blows; if it lies in the anterior chamber it should be removed; if it is dislocated into the vitreous it may be left; the eye will then, however, be probably lost. Rupture of the choroid without injury to the sclerotic is a less frequent result of a blow but sometimes occurs. The appearance of the white sclerotic through the crack in the choroid is very distinctly seen with the ophthalmoscope after the effusion of blood has been absorbed.

Tumours of the Eye.—Malignant growths are not uncommon in connection with the eyeball; sarcomatous tumours, with round or spindle-shaped cells and usually abundant pigment may commence in the choroid, ciliary region, or the back of the orbit. If the eye is not implicated, an attempt may be made to remove the tumour without injury to the eye if this proceeding appears possible. Excision of the tumour is the only treatment, and it usually involves excision of the eyeball.

Glioma is a very malignant form of sarcoma commencing in the retina; it usually occurs in young children and can be seen as a fungous growth at the back of the eye. Its progress is most painful; it affects both eyes frequently and always causes death, generally in a year or two, by extending to the brain. Excision eases the pain, and may prolong a miserable existence for a time, but the disease is sure to recur.

Osseous Plates are sometimes found in the choroid. An eye which has undergone this form of degeneration shrinks and is commonly very painful; excision is necessary or sympathetic ophthalmia may be produced.

Exophthalmos.—Protrusion of the eyeballs with retraction of the upper lid. This is a symptom of Grave's disease, the nature of which is not understood. There is usually an enlargement of the thyroid gland, hence it is often spoken of as exophthalmic goitre. The disease is more common in women than in men, and more severe in men. The principal symptoms are palpitation and great rapidity of the heart's action, with marked pulsation of the vessels of the head and neck. The enlargement of the thyroid is not generally considerable; it usually pulsates and its increased size is chiefly due to enlargement of its vessels. The disease is believed to be due to paralysis of the vasomotor nerves of the head and neck. The protrusion of the eyeballs is caused by an œdematous condition of the adipose tissue of the orbit, and probably also by an increased formation of fat. In women the disease is usually accompanied by disturbance of the uterine functions, scanty menses and marked anæmia. The eyes become fixed but there is seldom or ever any morbid change in the retina.

Treatment.—In extreme cases the eyes must be protected by pads applied over the lids, kept in place by a light bandage. Cases of exophthalmos usually improve by the administration of iron and iodine; digitalis and belladonna, exhibited in combination with iron and iodine, have been found efficacious. Ergot of rye and galvanism applied to the neck are also recommended. The prognosis is better in women than in men.

Cysticerci may occur in the vitreous, the anterior chamber, or beneath the retina. This affection is fortunately very rare. The removal of one from the anterior chamber has been perfectly successful; if they occur in the deeper structures there is little hope for the organ.

Echinococcus Cysts have frequently been removed from the orbit

Colour Blindness, Daltonism.—This is a remarkable, probably hereditary, defect of vision which is at present but little understood. In its minor degrees this affection is perhaps usually undiscovered, and it may exist even to a very great extent without being detected. Individuals suffering from this defect are usually able to distinguish colours by some peculiarity of shade or brightness. The author is intimately acquainted with a person who is absolutely colour blind, but who seldom makes any very remarkable error. The proof of the absolute colour blindness in this case is, that he can distinguish colours better in a light which to ordinary eyes destroys all colour, the light emitted by the flame of spirit in which salt has been dissolved. Scarlets, which to ordinary eyes appear white in such a light, seem to my friend brighter scarlets than by ordinary light. All colours appear to him as neutral shades, as far as I can learn from his descriptions. There is evidence that his mother's brother was colour blind; no other person in the family was affected as far as I can learn. The mother and her sisters are known to me to have excellent appreciation of colour.

There is no treatment, but such persons are manifestly unsuited for artists, or work in which the distinction of colour is important, as engine-driving on railways, &c.

Malformations of the Eye.—The iris may exhibit a gap in its lower portion (coloboma of the iris); this is due to arrested development. The coloboma may extend into the choroid from the same cause. The appearance with the ophthalmoscope is very distinctive, a large white gap is seen extending from the disc to the periphery of the fundus in its lower part. Vision will probably be good unless the coloboma involves the yellow spot. The membrane which in the fœtus closes the pupil may persist; this is, however, exceedingly rare.

APPENDIX.

FORMULÆ.

THE following are amongst the most useful formulæ, especially adapted to ophthalmic practice.

I.

SOLUTIO ARGENTI NITRATIS FORTIOR.

Strong Solution of Nitrate of Silver.

Take of

Nitrate of Silver . .	40 grains.
Distilled Water . .	1 fluid ounce.

Dissolve.

For painting the edges of the lids in tinea, hordeolum, &c.

This solution is too strong for application to the conjunctiva except in cases where its sensibility is much blunted by long continued disease. Solutions of nitrate of silver should not be dropped into the eye, as they are liable to stain the conjunctiva and cornea permanently.

II.

SOLUTIO ARGENTI NITRATIS MITIOR.

Solution of Nitrate of Silver.

Take of

Nitrate of Silver . .	10 grains.
Distilled Water . .	1 fluid ounce.

Dissolve.

This solution is usually employed in the treatment of granular lids. It should be applied with a camel's hair brush to the conjunctiva of the everted lid, and should be washed off thoroughly, either with the following solution, or with ordinary water, as soon as the granulations assume a faint opalescent tinge from its action.

III.

SOLUTIO SODII CHLORIDI.

Saline Solution.

Take of

Common Salt. . .	5 grains.
Water . . .	1 fluid ounce.

Dissolve.

For washing away any superabundant nitrate of silver from the conjunctiva. Ordinary water, however, usually contains a sufficiently quantity of chlorides to effect this object equally well.

IV.

Guttæ Zinci Chloridi.

Chloride of Zinc Drops.

Take of

Chloride of Zinc . .	1 grain.
Distilled Water . .	1 fluid ounce.

Dissolve.

V.

Guttæ Zinci Chloridi Mitior.

Weak Chloride of Zinc Drops.

Take of

Chloride of Zinc . .	½ grain.
Distilled Water . .	1 fluid ounce.

Dissolve.

These solutions should be perfectly fresh, as a flocculent precipitate of oxide of zinc and a free acid in the solution is liable to form. The solution then becomes exceedingly irritating. When fresh they are most useful antiseptic and astringent applications.

VI.

Guttæ Potassii Iodidi.

Iodide of Potassium Drops.

Take of

Iodide of Potassium .	10 grains.
Distilled Water . .	1 fluid ounce.

Dissolve.

Perhaps little more than a placebo, but extremely useful when more active measures are harmful.

VII.

GUTTÆ ATROPIÆ SULPHATIS FORTIOR.

Strong Solution of Sulphate of Atropine.

Take of

Sulphate of Atropine	4 grains.
Distilled Water	1 fluid ounce.

Dissolve.

VIII.

GUTTÆ ATROPIÆ SULPHATIS.

Solution of Sulphate of Atropine.

Take of

Sulphate of Atropine	2 grains.
Distilled Water	1 fluid ounce.

Dissolve.

These solutions are the most important to the ophthalmic surgeon; they must be made quite fresh and should contain neither spirit nor acid. The stronger solution is necessary to relax the accommodation completely in a short time, and also to break down recent adhesions of the iris. The weaker is sufficient, however, to maintain a dilated pupil. One or two drops in either case should be dropped into the eye three times in the day. When the iris is inflamed it may be necessary at first to apply the solution more frequently to accomplish the dilatation of the pupil.

The Action of Atropine.—When a drop of a solution of atropine of four grains to the ounce is dropped into the eye the pupil dilates. It attains its maximum of dilatation in about twenty-four minutes; contraction then commences, but according to Donders it does not attain its normal size for a fortnight, the contraction is so gradual.

Paralysis of the ciliary muscle commences about the period of the maximum of dilatation of the iris and attains to near its maximum in an hour. The near point of an emmetropic eye is now removed to forty-eight inches; some further paralysis occurs. On the second day after the application, the muscle begins to recover. By the fourth day the near point is again at seven inches, and no further inconvenience is felt, although entire recovery does not occur until the fourteenth day. The action of belladonna is due to the atropia it contains.

The active principle of the Calabar bean has the opposite effect to atropia; it produces contraction of the pupil and spasm of accommodation. If the quantity applied is too large the spasm is painful. With a drop of the solution of its active principle, eserine, gr. iv. ad ℥j, the action is far more transitory than that of atropine; its manifest effect on the accommodation usually passes off in an hour or two, although there is still some spasm left for two or three days. The contraction of the pupil attains its maximum in twenty minutes; it begins to dilate again in three or four hours and attains its normal diameter in from two to three days.

It is proposed to use this agent after extraction of the lens without iridectomy, to prevent entanglement of the iris in the wound; also to counteract the inconvenient effect of atropine, although its effects are too transient to do this satisfactorily; the atropia reasserts itself in about two hours. It is also sometimes ordered in paralysis of the ciliary muscle.

IX.

SOLUTIO CUPRI SULPHATIS.
Solution of Sulphate of Copper.

Take of

Sulphate of Copper . .	20 grains.
Distilled Water . .	1 fluid ounce.

Dissolve.

Used chiefly for brushing the conjunctiva of the eyelids in old standing granular ophthalmia as a change when a solution of nitrate of silver is no longer producing a beneficial effect.

X.

LOTIO ZINCI SULPHATIS.
Sulphate of Zinc Lotion.

Take of

Sulphate of Zinc . .	3 grains.
Distilled Water . .	1 fluid ounce.

Dissolve.

An astringent lotion, useful in chronic cases as a change with lotio aluminis.

XI.

Lotio Aluminis.

Alum Lotion.

Take of

Alum in powder . .	3 grains.
Distilled Water . .	1 fluid ounce.

Dissolve.

A mild astringent application most useful in catarrhal ophthalmia.

XII.

Lotio Aluminis Fortior.

Stronger Alum Lotion.

Take of

Alum	4 grains.
Distilled Water . .	1 fluid ounce.

Dissolve.

To be used with a small glass syringe in cases of purulent ophthalmia, at least once every hour.

XIII.

Lotio Aluminis cum Atropia.

Atropine and Alum Lotion.

Take of

Alum	2 grains.
Sulphate of Atropine .	$\frac{1}{8}$ of a grain.
Distilled Water . .	1 fluid ounce.

Dissolve.

A very useful collyrium in cases of chronic ulcer of the cornea; it is not generally admissible in recent cases.

XIV.

Lotio Ammoniæ Acetatis.

Acetate of Ammonia Lotion.

Take of

Solution of Acetate of Ammonia (British Pharmacopœia.)	1 fluid ounce.
Spirit of Nitrous Æther . .	2 fluid drachms.
Water, or elder-flower water, to make up . . .	8 fluid ounces.

Mix.

A valuable cooling lotion to be applied over the lids; useful in simple ophthalmia, phlyctenules, &c. If it is desired to be very cold, the quantity of nitrous æther should be increased.

XV.

Lotio Acidi Hydrocyanici.

Hydrocyanic Acid Lotion.

Take of

Dilute Hydrocyanic Acid .	1 fluid drachm.
Water, or Elder Flower Water	10 fluid ounces.

A useful sedative lotion in ulcer of the cornea.

XVI.

Lotio Boracis cum Glycerina.

Glycerine and Borax Lotion.

Take of

Biborate of Soda	2 drachms.
Glycerine	1 fluid ounce.
Water, to make	12 fluid ounces.

Mix.

To be used as an external application to the lids and face in eczema and excoriations, but not to be applied to the conjunctiva.

XVII.

Unguentum Hydrargyri Nitratis Mite.

Dilute Nitrate of Mercury Ointment.

Take of

Ointment of Nitrate of Mercury	1 drachm.
Prepared Lard	7 drachms.

Mix.

XVIII.

Unguentum Hydrargyri Oxidi Rubri Dilutum.

Dilute Red Oxide of Mercury Ointment.

Take of

Red Oxide of Mercury Ointment	2 drachms.
Prepared Lard	6 drachms.

Mix.

These ointments are useful in tinea tarsi. The former is most frequently used, but the latter often produces the best results when the former has been tried and has failed.

XIX.

UNGUENTUM HYDRARGYRI OXIDI FLAVI.

Yellow Oxide of Mercury Ointment.

Take of

The Yellow Oxide of Mercury .	10 grains.
(Supplement to British Pharmacopœia).	
Prepared Lard	1 ounce.

Mix.

A small piece introduced into the eye with a probe beneath the lower lid is often exceedingly useful in chronic ulcers of the cornea. Its effect must be watched, and if it sets up too much irritation the eye should be bathed to wash away the ointment thoroughly.

XX.

UNGUENTUM HYDRARGYRI IODIDI RUBRI.

Red Iodide of Mercury Ointment.

Take of

Red Iodide of Mercury . .	16 grains.
Prepared Lard . . .	1 ounce.

Mix.

This ointment should be rubbed in on the temple once a day. It combines a mild counter-irritant and mercurial. Care must be taken not to destroy the cuticle by its too vigorous or prolonged application, as salivation would be rapidly induced under these circumstances. It is exceedingly useful in indolent forms of specific iritis.

XXI.

UNGUENTUM BELLADONNÆ COMPOSITUM.

Compound Belladonna Ointment.

Take of

Mercurial Ointment .	. 6 drachms.
Extract of Belladonna .	. 2 drachms.

Mix.

Useful in cases of iritis in which atropine is not admissable from the temperament of the patient.

XXII.

FOTUS BELLADONNÆ.

Belladonna Fomentation.

Take of

Extract of Belladonna .	2 drachms.
Boiling Water .	. 10 fluid ounces.

Dissolve.

This solution may be used either warm or cold according to the feelings of the patient. The warm application is the more efficacious.

TEST TYPE.

Two forms of test type are in common use in this country, Snelling's and Jager's.

Dr. Snelling's test types are used for the determination of the acuteness of vision and for the correction of all forms of ametropia. The numbers indicate the number of feet at which each set of letters is seen distinctly with vision of average sharpness, or, more accurately, the distance at which the letters occupy an angular measure of five minutes.

The letters are printed in Egyptian type, the copyright is the property of the Netherlands Ophthalmic Hospital, for the benefit of which they are sold in London by Williams and Norgate.

Dr. Jager's test types are numbered arbitrarily, and are used for near vision, chiefly for the determination of the power of accommodation; No. 1 Jager seen at a foot corresponds nearly to Snelling's No. 20 at twenty feet, but not exactly.

The type is that known to printers as Brilliant. An example is given:

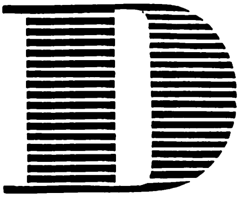
'The place of our retreat was in a little neighbourhood, consisting of farmers who tilled their own ground, and were equal strangers to opulence and poverty. As they had almost all the conveniences of life within themselves, they seldom visited towns or cities in search of superfluities. Remote from

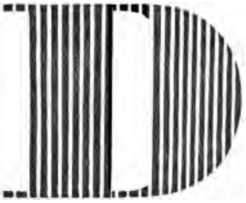
No. 20 Jager consists of 8-line Roman, without capitals:

the

The others are intermediate. These types are printed for the use of the Royal Ophthalmic Hospital at Moorfields, from the secretary of which they can be obtained at a moderate price.

A set of test types for the determination of astigmatism, in which the letters are formed of short lines with various degrees of inclination, were first introduced by Orestes Pray.





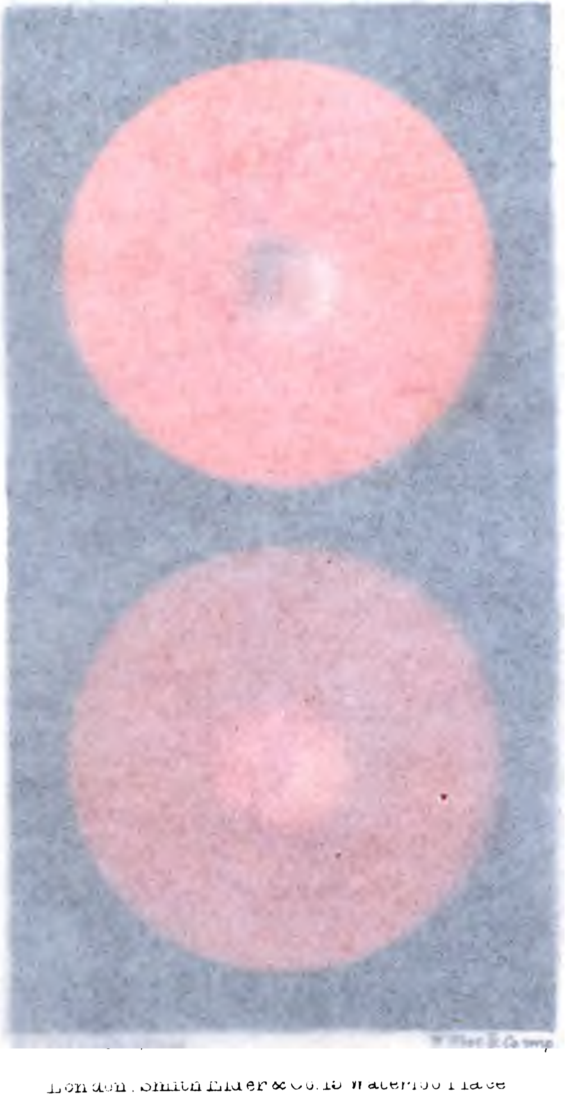
When seen at a distance, the letters which are most distinct are those in which the lines lie in the axis of the greatest ametropia.

PLATE I.

Fig. 1.—The fundus of a myopic eye from a fair patient. The choroidal pigment is in small quantity. There is a well marked physiological cup and myopic crescent (commencing posterior staphyloma), which has a dead white appearance owing to atrophy of the choroid and retina.

PLATE I.

Fig. 2.—The fundus of an hypermetropic eye with congestion of the optic disc. The choroidal pigment is moderately developed. The edges are red and ill-defined. In such a case astigmatism should be suspected.



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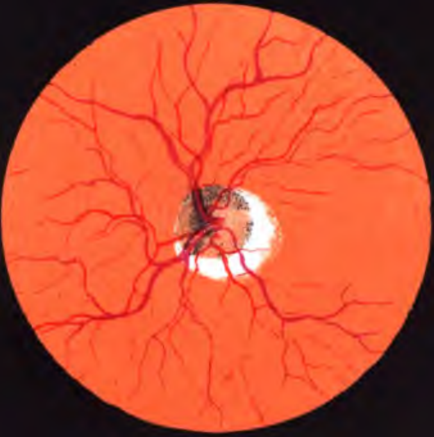

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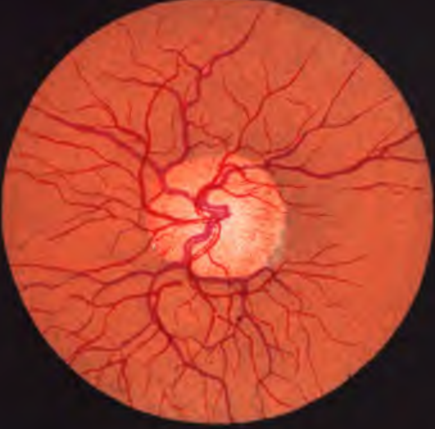

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PLATE II.

Fig. 3.—The fundus of an eye affected with retinitis pigmentosa.

PLATE II.

Fig. 4.—The fundus in a case of white atrophy. The vessels of the retina are reduced to mere threads, and the disc is bloodless. The details of the lamina cribrosa are too plainly seen. On the right side of the fundus the vessels of the choroid are very apparent, indicating the commencement of choroidal atrophy.

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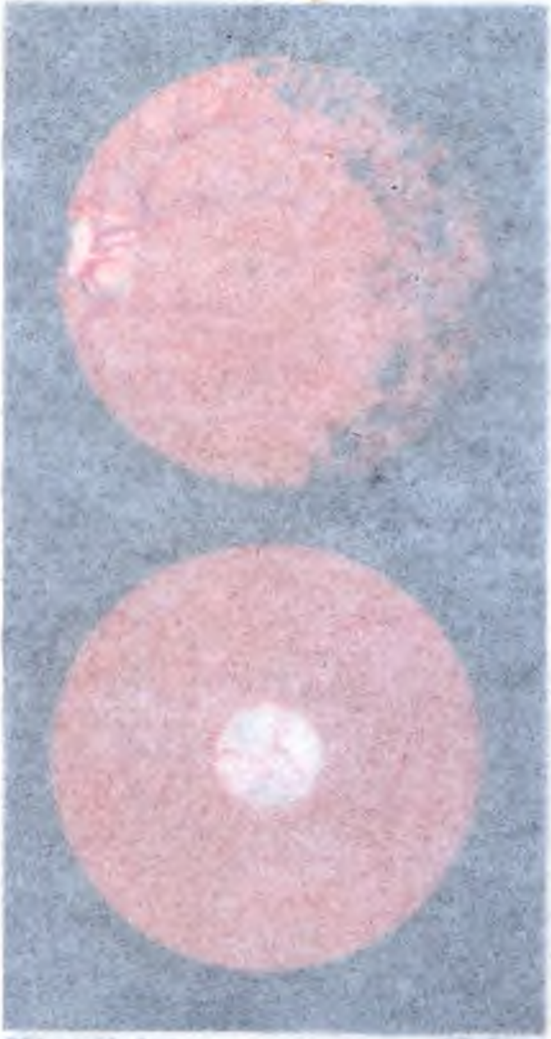

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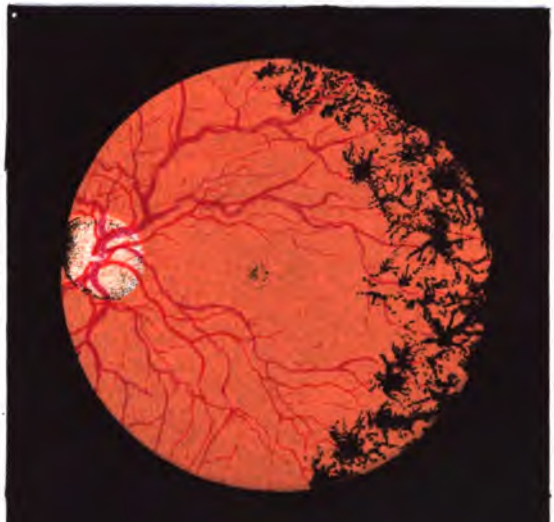

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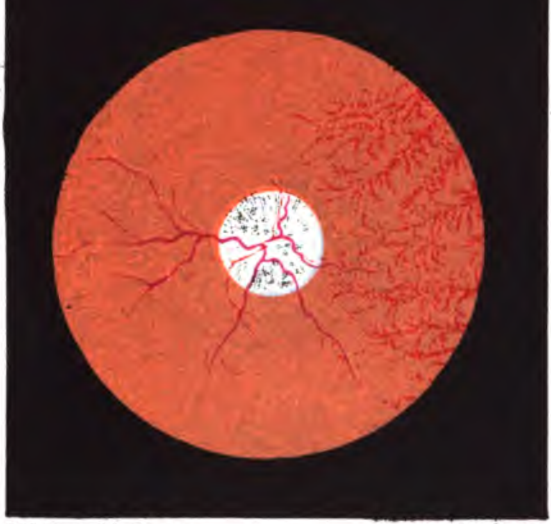

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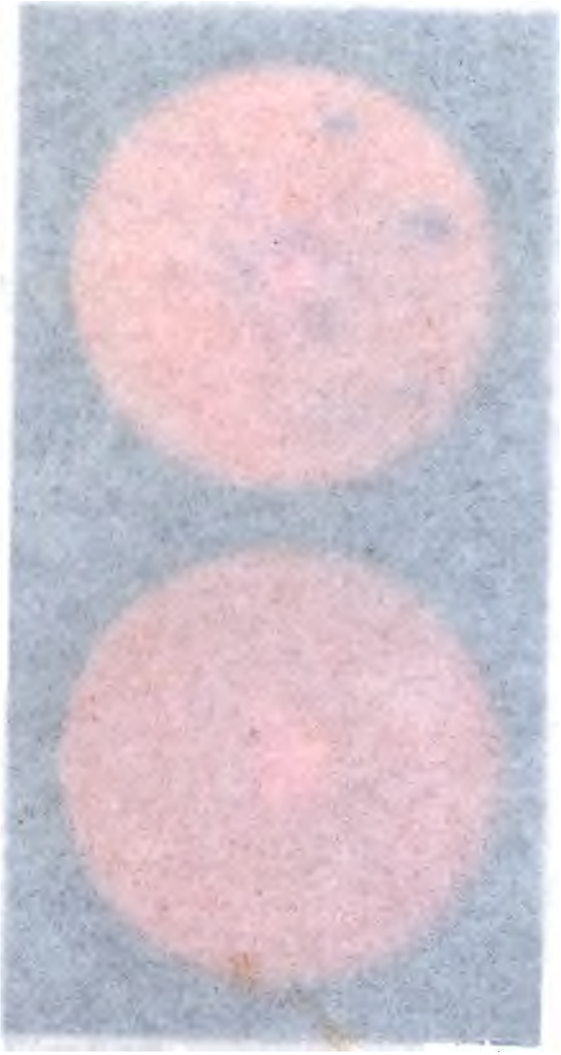
PLATE III.

Fig. 5.—The fundus in a case of hæmorrhagic retinitis. Numerous ecchymoses are seen, especially in and around the optic disc.

PLATE III.

Fig. 6.—A well-marked glaucomatous cup from a case of confirmed glaucoma. The vessels appear interrupted at the edge of the cup.



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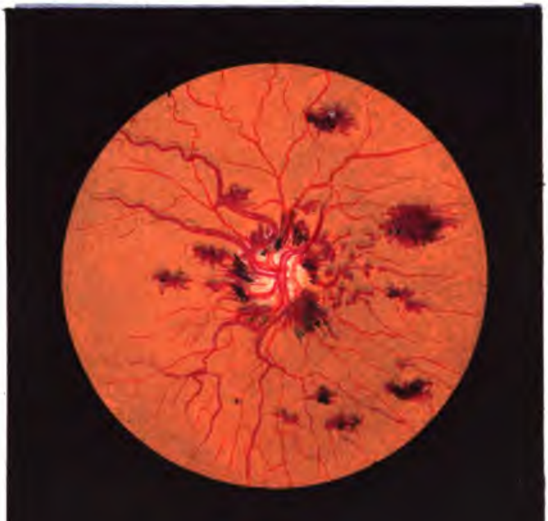

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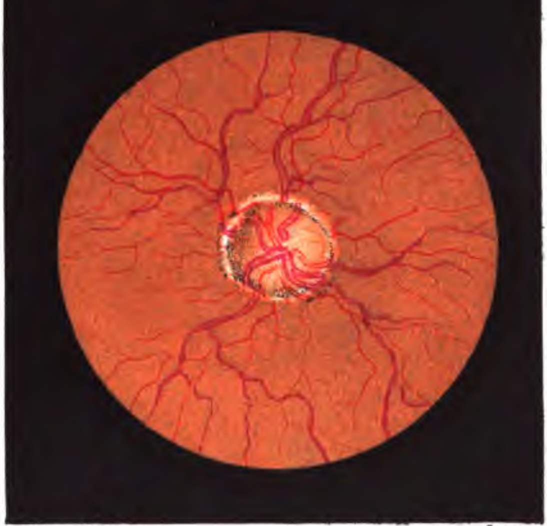

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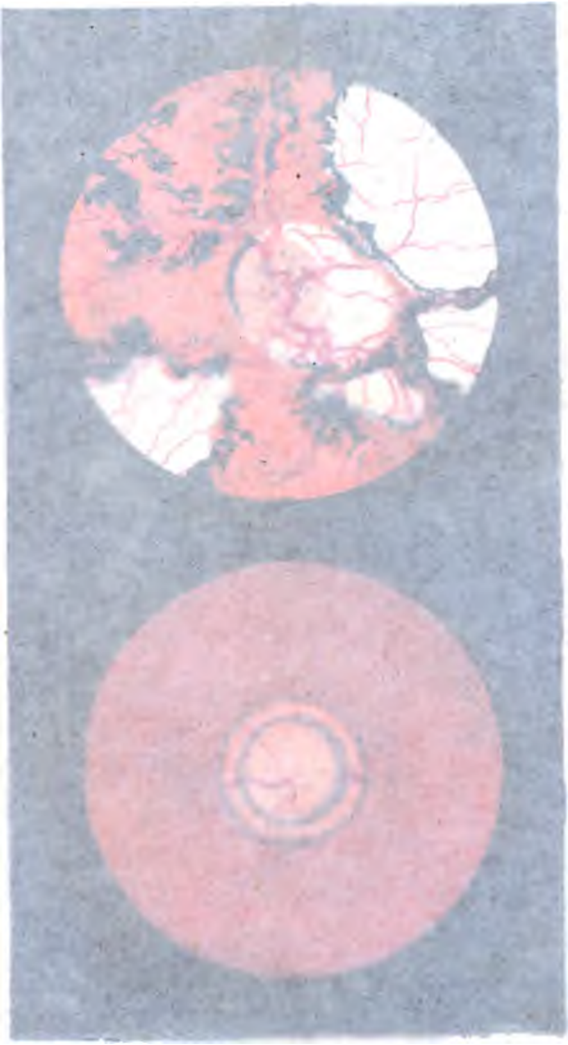
PLATE IV.

Fig. 7.—The fundus of an eye in which the choroid has undergone extensive changes, the result of long-standing syphilitic choroido-retinitis. Vision remained in portions of the field. There is a large posterior staphyloma and the choroidal pigment is entirely destroyed in large patches; around these are others in which it is greatly hypertrophied.

PLATE IV.

Fig. 8.—The fundus in a case of embolism of the arteria centralis. There is considerable atrophic cupping of the disc; the details of the lamina cribrosa are too plain; the arteries are reduced to mere threads and the veins are almost empty except one on the inner side and a large one on the swollen edge of the disc which contains a single drop of blood in a portion of its course. This appearance is very characteristic.



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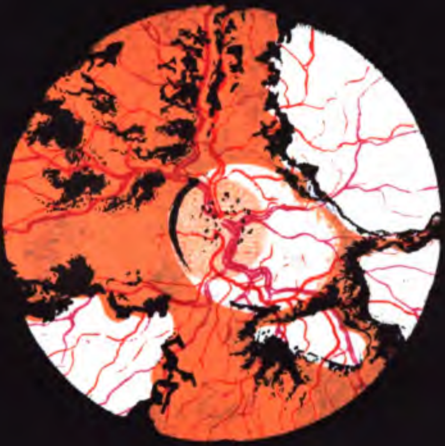

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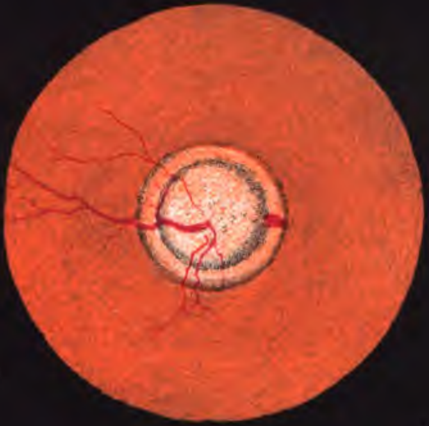

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INDEX.

ABLATION of the eyeball, 34
Abnormal appearances of the retina, congenital, 128
Abrasions of the cornea, 159
Accommodation in myopia, 56
— measure of, 48
— mechanism of, 48
— paralysis of, 95
— spasm of, 96
Action of Atropine, 173
— of Calabar bean, 173
Acuteness of vision, 51
Adjustment of eyeball in external squint, 93
— of glasses in frames, 81
After treatment of cataract operations, 124
Albuminuria, retinitis in, 135
Amaurosis, 129
Amblyopia, 129
Ametropia, 47
— a cause of ciliary spasm, 97
Anterior chamber, effusion of blood into, 161
— — paracentesis of, 27
Anterior polar cataract, 113
Aphakia, 125
— cylindrical glasses in, 125
— sharpness of vision in, 126
Aquocapsulitis, 104
Arcus senilis, 26
Arteria centralis, embolism of, 139
Artificial eye, 36
— pupil in lamellar cataract, 118
Asthenopia, 52
Astigmatism, 62
— a cause of ciliary spasm, 97
— irregular, 73
— mixed, 73
Atrophy of optic disc, 140
— white, 140
Atropine, action of, 173

BLOWS, effects of, 161
Bowman's, Mr., trephine, 74
Boxes of glasses, 77

CALABAR bean, action of, 173
Capsular cataract, 111
Cataract, 111
— artificial pupil for, 118
— congenital, 114
— flap operation in, 122
— Graefe's operation in, 119
— needle operation in, 114
— polar, 113

Catarrhal ophthalmia, 15
Causes of myopia, 59
— of strabismus, 85
Choked disc, 137
Choroid, rupture of, 162
Chronic ophthalmia, 14
Ciliary muscle, spasm of, 96
— — function of, 48
Ciliary staphyloma, 33
Circumferential cataract, 112
Coloboma of iris, 167
Colour blindness, 165
Congenital abnormalities of the retina, 128
— cataract, 114
Conical cornea, 73
Conjunctiva, ecchymosis under, 161.
— inflammation of, 10
— phlyctenules of, 21
Convergent squint, 85
Cornea, abrasions of, 159
— conical, 73
— fistula of, 32
— foreign bodies in, 160
— opacities of, 32
— perforating ulcer of, 28
— sloughing ulcer of, 30
— serpiginous ulcer of, 31
— ulcers of, 30
— unequal curvature of meridians of, 62
Corneitis, 26
— interstitial, 29
— phlyctenular, 27
— suppurative, 26
— syphilitic, 59
Corrective spectacles, 79
Couper J., Mr., on myopia, 57
Couper's ophthalmoscope, 70
Critchett, Mr., operation for ablation, 34
— — — for artificial pupil, 118
— — — for squint, 89
Crystalline lens, dislocation of, 162

Cupped disc in glaucoma, 153
Cyclitis, 105
Cylindrical lenses, 38, 78
Cysticercus in the eye, 165
Cysts, 2

DACRYO-CYSTITIS, 6
Daltonism, 165
Dangers of lead lotion, 28
Defective vision in squint, 87
Detachment of retina, 141
Difference of refraction in the two eyes, 72
Diphtheritic ophthalmia, 18
— paralysis of accommodation, 95
Diplopia, 92
Disc choked, 137
— ischæmia of, 137
— in glaucoma, 153
Diseases of eyelid, 1
— of lachrymal apparatus, 5
— of retina, 131
Dislocation of the lens, 162
Disuse of retina, effects of, 87
Divergent squint, 84
Double images, 84

ECCHYMOSIS under conjunctiva, 161
Echinococcus cysts in orbit, 165
Ectropium (*or Ectropion*), 9
Effusion of blood into anterior chamber, 161
— — — into vitreous, 161
— — — under conjunctiva, 161
Embolism of arteria centralis, 139
Emmetropia, 47
Entropium, 8
Episcleritis, 23
Epiphora, 3
Eversion of eyelid, 9
Excavated disc in glaucoma, 153

EXC

Excision of eyeball, 35
— of suppurating eyeball, 110
Eyeball, removal of, 35
— rupture of, 162
— tension of, 97
Eyelid, eversion of, 9
— inversion of, 8
Eyes, difference between the two, 72

FATIGUE in astigmatism, 64
Field of vision, 129
Fistula of cornea, 32
— lachrymal, 7
Flap, extraction, 122
Focal lengths of glasses, 77
Focus of a lens, 39
Foreign bodies in the cornea, 160
— — in the eye, 161
— — in the orbit, 161

GLASSES, adjustment of, in frames, 81
— cylindrical, 78
— refractive power of, 76
— trial boxes of, 77
Glaucoma, 145
— acute inflammatory, 150
— confirmed, 148
— fulminans, 151
— iridectomy in, 155
— maligna, 158
— premonitory, 146
— secondary, 154
— simple, 148
Glaucomatous cup, 153
Glioma, 163
Graefe, Von, discoverer of iridectomy, 155
— — operation for cataract, 119
Granular ophthalmia, 18
Grave's Disease, 164
Goitre, exophthalmic, 164

JAV

HÆMORRHAGE into anterior chamber, 161
— into retina, 138
— into vitreous, 161
Hard cataract, operations for, 119
Healthy retina, appearance of, 127
Heurteloup, use of the, 58
Hordeolum, 3
Hydrophthalmia, 37
— iridectomy in, 37
Hyperæmia of retina, 132
Hypermetropia, 51
— squint in, 85
Hypopion, 27, 31
Hutchinson, Mr., on tobacco atrophy, 141

IDIOPATHIC retinitis, 137
Inflammation of conjunctiva, 10
— of cornea, 26
— of iris, 98
— of lachrymal sac, 5
— of retina, 131
Inflammatory glaucoma, 150
Injuries to eye, 159
Insufficiency of internal rectus, 92
Interstitial corneitis, 29
Inversion of eyelid, 8
Iris, coloboma of, 167
— inflammation of, 98
— paralysis of, 95
— effect of atropine on, 173
Iritis, 98
Iridectomy, discoverer of, 155
— in iritis, 101
— in glaucoma, 152, 155
— operation of, 102
Irido-choroiditis, 104
Irregular astigmatism, 73
Ischæmia of disc, 137

JAVAL optometer, 66

LACHRYMAL ducts, direction of, 5
— — stricture of, 5
— fistula, 7
Lamellar cataract, artificial pupil for, 118
Lead lotion, dangers of, 28
Lens, dislocation of the, 162
Lenses, 38
— meniscus, 80
Lenticular cataract, 111
Liebreich, Mr., operation for squint, 91
Linear extraction, 116

MALFORMATIONS of the eye, 167
Malignant tumours, 163
Measure of accommodation, 48
— of acuteness of vision, 51
— of astigmatism, 62
— — — by the ophthalmoscope, 71
— of glasses, 76
— of hypermetropia, 51
— of myopia, 54
— of presbyopia, 49
— of tension, 98
Meniscus lenses, 80
Mixed astigmatism, 73
Moorfield's operation for squint, 89
Mucocele, 5
Muscæ, 59
Myopia, 54
— accommodation in, 56
— causes of, 59
— extreme, 57
— prognosis of, 59
— progressive, 59
— squint in, 84
— treatment of, 55

NEAR point, 49
Needle operation for cataract, 114
Nephritic retinitis, 135
Neuro-retinitis, 131–134
Nystagmus, 94

ONYX, 26
Opacities of the cornea, 32
Operation for cataract, 119
— — removal of eyeball, 35
— — squint, 89
— — xerophthalmia, 37
— of iridectomy, 102
Opium in iritis, 101
Ophthalmia, 10
— catarrhal, 15
— chronic, 14
— phlyctenular, 21
— sequelæ of, 11
— simple, 11
— strumous, 21
Ophthalmoscope, 42
Ophthalmoscopic appearance of healthy retina, 127
— in conical cornea, 74
— determination of refraction, 69
Optic disc, atrophy of, 140
— — in glaucoma, 153
Optometer, Javal, 66
Orbit, impaction of foreign bodies in, 161

PANNUS 19
Panophthalmitis, 109
Pantascopic spectacles, 81
Paracentesis of anterior chamber, 27
Paralysis of accommodation, 95
— of iris, 95
— squint from, 87
Parasites in the eye, 165
Penetrating wounds, 160
Perforating ulcers of the cornea, 28
Periscopic glasses, 80

Peritomy, 20
— in ulcers of the cornea, 31
Persistent pupillary membrane, 168
Phlyctenular corneitis, 27
— ophthalmia, 21
Phlyctenules, 21
Phosphenes, 131
Pigment, deposits of, in retinitis, 136, 143
Pinguecula, 25
Polar cataract, 112
Positive and negative lenses, 38
Posterior staphyloma, 58
Premonitory glaucoma, 146
Presbyopia, 49
Prognosis of myopia, 59
Progressive myopia, 59
Protective spectacles, 79
Pterygium, 24
Purulent ophthalmia, 16
Pupillary membrane, persistence of, 168

REFRACTION, 47
— determination of by ophthalmoscope, 67
Removal of eyeball, 35
Retina, detachment of, 141
— diseases of, 131
— dropsy of, 133
— hæmorrhage into, 138
— hyperæmia of, 132
Retinitis, 131-134
— albumenurica, 135
— idiopathic, 137
— nephritic, 135
— pigmentosa, 143
— serous, 133
— syphilitica, 136
Rheumatic iritis, 99
Rupture of the choroid, 163
— of the sclerotic, 162

SAC, lachrymal, inflammation of, 5
— — suppuration of, 6
Sclerotic, rupture of, 162
Sclerotomy, 150
Scotomata, 130
Secondary cataract from iritis, 100
— glaucoma, 154
Senile cataract, 112
Sequelæ of ophthalmia, 11
Serous iritis, 104
— retinitis, 133
Serpiginous ulcer of cornea, 31
Seton in ulcer of cornea, 30
Simple glaucoma, 148
— ophthalmia, 11
Sloughing ulcers of cornea, 30
Spasm of ciliary muscle, 96
Spectacles, 79
— pantascopic, 81
— periscopic, 80
Spectra in irido-choroiditis, 105
Spherical lenses, 38
Squint, 83
— causes of, 85
— defective vision in, 87
— in children, 87
Stenopaic slit, 64
Staphyloma, 18-33
— ablation of, 34
— posticum, 58
Strabismus, 83
— from paralysis, 87
Stricture of the lachrymal duct, 5
Strumous ophthalmia, 21
Stye, 3
Suppuration in the lachrymal duct, 6
— in the vitreous body, 109
Suppurative corneitis, 26
— iritis, 99
Sympathetic ophthalmia, 106
Syphilitic corneitis, 29
— iritis, 99
— retinitis, 136

TES

TEST of refractive power of glasses, 76
Test type, 180
Tenon's capsule, 91
Tension in glaucoma, 146
— of eyeball, 97
Tinea tarsi, 1
Tobacco atrophy, 141
Trephine in conical cornea, 74
Trial glasses, 77
Trichiasis, 7
Tumours in eye, 163
Turpentine in iritis, 101

ULCERS of cornea, 30
— sloughing, 30
Unsteadiness of eyeball, 94

YEL

VASCULAR ulcers of cornea, 30
Vertical and horizontal curves of cornea, 62
Vision, acuteness of, 51
— field of, 129
Vitreous, effusion of blood into, 161
— suppuration in, 109

WHITE atrophy, 140
Wounds, penetrating, 160

XEROPHTHALMIA, 36

YELLOW spot, the, 128

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